

# PART 1

## Creating and Using Databases

Clinton P. MacDonald  
Dianne S. Miller

Sonoma Technology, Inc.

# Creating and Using Databases

## We will cover

- Using databases to create one data table ready for tool development
  - how to get individual data sets into the database
  - how to merge tables
- Mining the data in the database
- Setting up a simple interface in MS Access to run your tool

Lots of material! This part covers the minimum that you'll need to get started

# Outline

- Overview
  - About Databases
  - Components of a Database
- Populating a Database
  - Importing
  - Keying
  - Checking
- Using a Database
  - Queries
  - SYSTAT
  - Export
  - Forecast tools

# About Databases – Why use a database?

- Stores large amount of data (much more than Excel)
- Easy to merge different data sets
- Easy to query data
- Scalable
- Readable by other programs including statistical packages
- Can be set up as a forecast system that computes and stores forecasts
- Can be linked to e-mail systems for forecast dissemination

## Number of records

Excel = 65,000

Access = 2 million

SQL = trillions (storage capacity is ~1 terabyte)

Oracle = trillions (storage capacity is ~1 terabyte)

# About Databases

- Storage system that organizes data for quick retrieval
- If properly designed, data can be trusted more than when stored in other platforms
- Some common types
  - MS Access, SQL, Oracle
- Structure types
  - Flat (simple)
    - Easy to develop and use
    - Not easily scalable or space efficient
  - Relational (complex)
    - More difficult to develop
    - Easily scalable
    - Space efficient
    - No repeated information
- We'll focus on MS Access (v.2002) with simple structure

# About Databases – Flat

Descriptor fields

Data fields

WSH	Site	Date	LST	PM25	MaxOfT	MinOfT	AvgOfDPT	SumOfClouds	Clouds	SumOfPrecip	DeltaP	WS12a6a	WD12a6a	WS6a12p	WD6a12p
	WSH	1/15/1999	12	3	-6	-2.84615		22	1.6923	0.1	-5.100	1.207812	326.5061	2.546039	323.7052
	WSH	1/16/1999	15	11	-6	-2.15385		22	1.6923	0	2.8	0.645876	181.1222	3.049036	199.5243
	WSH	1/17/1999	22	14	-3	-1.61538		22	1.6923	0	0.7000	0.303166	262.3915	0.160792	335.1111
	WSH	1/18/1999	14	10	1	5.923077		29	2.4167	0.54	3.7	0.218571	319.9998	0.617617	218.0449
	WSH	1/19/1999	8	12	-1	-5.30769		14	1.0769	0	-4.300	2.626019	201.7658	3.387815	232.4268
	WSH	1/20/1999	13	9	-1	3.230769		31	2.3846	0.04	-0.100	1.93758	14.89067	0.870860	2.127921
	WSH	1/21/1999		6	-2	2.923077		36	2.7692	0.17	0.7	0.218571	9.999924	0.681869	341.3508
	WSH	1/22/1999		9	4	6.076923		18	3	0	-0.8	0.890555	0.605714	0.904871	350.2183
	WSH	1/23/1999		21	7	14.23077		22	2.4444	0.13	7.5	0.149685	336.9354	2.192787	153.3120
	WSH	1/24/1999		16	3	7.307692		31	2.3846	0.29	-6.6	3.966549	185.1203	2.366517	335.3783
	WSH	1/25/1999		8	0	-0.46154		25	1.9231	0	-4.800	2.224412	325.3146	1.179173	314.3583
	WSH	1/26/1999		9	-1	-1.53846		16	1.2308	0	3.4	1.440562	0.775087	0.483555	207.0425
	WSH	1/27/1999		14	-4	1.153846		30	2.3077	0	11.400	0	0	1.544480	199.2766
	WSH	1/28/1999		18	2	7.153846		32	2.4615	0	0.5			1.44326	206.4818
	WSH	1/29/1999	16	9	-2	-2.46154		26	2	0	-4	6.384267	347.5356	5.275268	338.9004
	WSH	1/30/1999	16	8	-5	-3.84615		13	1	0	-2.600	0	0	2.357102	333.4609
	WSH	1/31/1999	12	2	-7	-10.1538		23	1.7692	0	1.1	3.126041	13.36111	2.701886	20.93626
	WSH	2/1/1999		3	-9	-4.38462		35	2.6923	0.03	8.2000	0.648903	217.2430	0.617525	211.6397
	WSH	2/2/1999	18	8	1	5.538462		36	2.7692	0.1	7.4	2.130457	339.4835	0	0
	WSH	2/3/1999	6	12	3	-2.61538		13	1	0	-2.800	1.782754	318.1933	4.391755	337.4355
	WSH	2/4/1999	13	12	4	5		28	2.1538	0.01	-2.600	1.463183	172.0340	1.023459	198.3919
	WSH	2/5/1999	11	10	2	-6.61538		12	0.9231	0	0.8	5.784597	321.8998	4.07538	335.0669
	WSH	2/6/1999	19	13	2	1		30	2.3077	0.02	2	1.205051	181.4838	0.168766	117.1970
	WSH	2/7/1999	23	5	-1	1.818182		32	2.9091	0.01	8.7000	0.579275	81.78687	1.088882	139.7553
	WSH	2/8/1999	20	7	-3	1.692308		31	2.3846	0	-7.9	2.379027	0.929247	4.758158	343.9832
	WSH	2/9/1999	14	11	-3	2.923077		36	2.7692	0	4.7000	1.979962	185.7793	5.795377	198.874
	WSH	2/10/1999	6	14	-1	-3.41667		15	1.25	0	-1.700	2.473439	291.6437	4.210705	317.2775
	WSH	2/11/1999	16	19	-2	0.75		16	1.3333	0	6.2	0	0	3.653112	198.0179
	WSH	2/12/1999	10	17	2	2.692308		15	1.1538	0.01	7	4.59	179.9999	4.59	179.9999
	WSH	2/13/1999	6	2	-3	-10.5395		17	1.3077	0	-8.4	2.719135	193.8729	5.555753	289.0568

Record: 20 of 1097

This is our goal – one data table with merged meteorological data ready to be used in a statistical program

# About Databases – Relational

Descriptor fields    Data field

uMetData	uRegion	uMetPara	dInitGMT	iFcstPeriod	rValue
14810617	31	95	5/1/2003	0	297.94461
14810618	32	95	5/1/2003	0	283.42383
14810619	33	95	5/1/2003	0	295.88562
14810620	34	95	5/1/2003	0	290.16251
14810621	35	95	5/1/2003	0	299.74475
14810622	18	95	5/1/2003	0	294.09238
14810623	36	95	5/1/2003	0	289.90094
14810624	37	95	5/1/2003	0	290.31503
14810625	8	95	5/1/2003	0	281.83212
14810626	10	95	5/1/2003	0	287.65968
14810627	38	95	5/1/2003	0	288.13708
14810628	39	95	5/1/2003	0	299.69476
14810629	19	95	5/1/2003	0	298.24011
14810630	40	95	5/1/2003	0	291.54431
14810631	11	95	5/1/2003	0	295.01675
14810632	3	154	5/1/2003	0	-2.09574
14810633	2	154	5/1/2003	0	0.55298
14810634	4	154	5/1/2003	0	-2.31538
14810635	1	154	5/1/2003	0	-1.92038
14810636	5	154	5/1/2003	0	1.51319
14810637	14	154	5/1/2003	0	-2.13803
14810638	20	154	5/1/2003	0	-3.21311
14810639	15	154	5/1/2003	0	-2.69073
14810640	21	154	5/1/2003	0	-1.76814
14810641	17	154	5/1/2003	0	-3.47273
14810642	22	154	5/1/2003	0	-1.12457
14810643	23	154	5/1/2003	0	-3.39128
14810644	24	154	5/1/2003	0	-2.71107

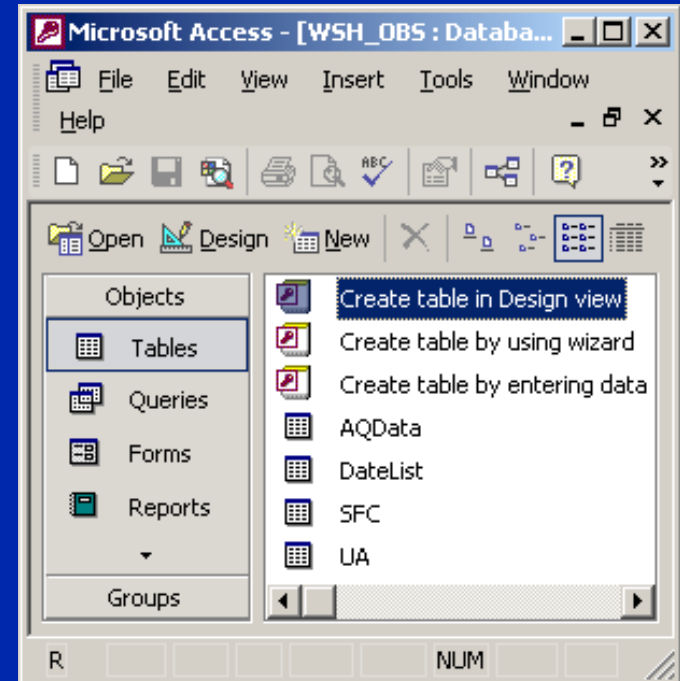
Region	sState	sRegionID	sName	rLatitu	rLongit	dCreated	iGMT
3	MN	MIN	Minneapolis	44.69	-92.79	1/2001 17:23:00	6
13	na	na	Unknown			3/2002 13:41:00	6
4	TN	NAS	Nashville	36.12	-85.56	1/2001 17:23:00	6
31	LA	NWO	New Orleans	30.07	-89.93	3/2003 15:23:00	6
32	NY	NYC	New York Ci	40.6	-74.13	3/2003 15:24:00	5
33	FL	ORL	Orlando	28.51	-81.37	3/2003 15:24:00	5
34	PA	PHL	Philadelphia	39.95	-75.15	3/2003 15:25:00	5
35	AZ	PHO	Phoenix	33.54	-112.1	3/2003 15:26:00	7
18	PA	PIT	Pittsburgh	40.43	-79.98	2/2002 17:24:00	5
36	OR	POR	Portland	45.54	-122.7	3/2003 15:27:00	8
5	CA	SAC	Sacramento	38.56	-120.5	1/2001 17:23:00	8
38	WA	SEA	Seattle-Belle	47.48	-121.8	3/2003 15:29:00	8
10	CA	SFO	San Francisco	37.75	-122.4	3/2002 16:54:00	8
11	CA	SBY	San Jose	36.77	-119.7	3/2002 17:01:00	8

uMetPara	uMetDef	sModelID	uLevelTyp	iLevel	dCreated
151	33 ETA		100	950	9/2001 18:21:00
152	33 ETA		100	975	9/2001 18:21:00
153	33 ETA		100	1000	9/2001 18:21:00
154	33 ETA		105	10	9/2001 18:21:00
155	33 ETA		109	1	9/2001 18:21:00
156	33 ETA		109	2	9/2001 18:21:00
158	33 ETA		116	1539	9/2001 18:21:00
159	33 ETA		116	2310	9/2001 18:21:00

uMetDef	sName	sParam	dCreated
20	Visibility [m]	VIS	3/2001 17:50:00
24	Barrel lifted index (ft)	BLI	3/2001 17:50:00
33	u wind [m/s]	UGRD	3/2001 17:50:00
34	v wind [m/s]	VGRD	3/2001 17:50:00
35	Stream function [m^2	STRM	3/2001 17:50:00

# Components of a Database

- Tables – where the data are stored
- Queries – used to extract or manipulate data in tables
- Forms – used to simplify data entry and/or computations
- Reports – used to visualize data, data summaries, and charts





# Components of a Database – Tables

Fields  $\xrightarrow{256 \text{ maximum}}$

1 record

Records

~2 million  
maximum  
for Access

Site	Date GMT	Time GMT	Date LST	Time LST	WD	WS (m/s)	Temp (C)	DPTemp (C)	Precip	Clouds	SLP	Altimeter
KIAD	1/1/1999	00:00:00	12/31/1998	18:00:00	0	0	-8	-9	0	SCT	1020.5	30.12
KIAD	1/1/1999	01:00:00	12/31/1998	19:00:00	0	0	-8	-10	-999	CLR	1020.2	30.11
KIAD	1/1/1999	02:00:00	12/31/1998	20:00:00	0	0	-9	-11	-999	CLR	1020.5	30.12
KIAD	1/1/1999	03:00:00	12/31/1998	21:00:00	0	0	-10	-12	0	SCT	1020.7	30.13
KIAD	1/1/1999	04:00:00	12/31/1998	22:00:00	0	0	-11	-13	-999	SCT	1020.5	30.12
KIAD	1/1/1999	05:00:00	12/31/1998	23:00:00	200	2.04	-11	-13	-999	SCT	1021	30.14
KIAD	1/1/1999	06:00:00	1/1/1999	00:00:00	0	0	-10	-11	0	SCT	1020	30.11
KIAD	1/1/1999	07:00:00	1/1/1999	01:00:00	0	0	-11	-13	-999	SCT	1020.5	30.12
KIAD	1/1/1999	08:00:00	1/1/1999	02:00:00	0	0	-12	-14	-999	SCT	1021	30.14
KIAD	1/1/1999	09:00:00	1/1/1999	03:00:00	0	0	-9	-11	0	BKN	1021.1	30.14
KIAD	1/1/1999	10:00:00	1/1/1999	04:00:00	0	0	-9	-11	-999	OVC	1021	30.14
KIAD	1/1/1999	11:00:00	1/1/1999	05:00:00	0	0	-11	-12	-999	SCT	1021.9	30.16
KIAD	1/1/1999	12:00:00	1/1/1999	06:00:00	180	1.53	-12	-13	0	SCT	1023	30.2
KIAD	1/1/1999	13:00:00	1/1/1999	07:00:00	0	0	-9	-11	-999	SCT	1024	30.22
KIAD	1/1/1999	14:00:00	1/1/1999	08:00:00	300	4.59	-3	-8	-999	SCT	1025.3	30.27
KIAD	1/1/1999	15:00:00	1/1/1999	09:00:00	320	6.63	-2	-12	0	SCT	1026.8	30.31
KIAD	1/1/1999	16:00:00	1/1/1999	10:00:00	310	9.69	-2	-13	-999	SCT	1027.9	30.34
KIAD	1/1/1999	17:00:00	1/1/1999	11:00:00	330	8.16	-1	-13	-999	SCT	1028.2	30.35
KIAD	1/1/1999	18:00:00	1/1/1999	12:00:00	310	8.67	-1	-14	0	BKN	1027.9	30.34
KIAD	1/1/1999	19:00:00	1/1/1999	13:00:00	290	5.61	-2	-14	-999	BKN	1027.8	30.34
KIAD	1/1/1999	20:00:00	1/1/1999	14:00:00	310	5.1	-2	-14	-999	BKN	1028.5	30.36
KIAD	1/1/1999	21:00:00	1/1/1999	15:00:00	300	3.57	-2	-16	0	BKN	1029.4	30.39
KIAD	1/1/1999	22:00:00	1/1/1999	16:00:00	340	3.57	-3	-15	-999	OVC	1029.9	30.4
KIAD	1/1/1999	23:00:00	1/1/1999	17:00:00	360	4.08	-4	-14	-999	OVC	1031.6	30.45
KIAD	1/2/1999	00:00:00	1/1/1999	18:00:00	340	4.59	-4	-15	0	BKN	1032.8	30.49

Record: 1 of 26085

# Components of a Database – Table Design

Describes the attributes of the data

- Data types
  - Text
  - Numeric
  - Date/time
  - Etc.
- Primary keys
  - Field(s) that are required to be unique (i.e., no duplicates)
  - For this example, date and time should be unique
  - Ensures integrity so that you can trust your data

The screenshot shows the 'SFC : Table' design view in Microsoft Access. The table has the following fields:

Field Name	Data Type	Description
Site	Text	
Date GMT	Date/Time	
Time GMT	Date/Time	
Date LST	Date/Time	
Time LST	Date/Time	
WD	Number	
WS (m/s)	Number	
Temp (C)	Number	
DPTemp (C)	Number	
Precip	Number	
Clouds	Text	
SLP	Number	
Altimeter	Number	

The 'Field Properties' pane is open for the 'WS (m/s)' field, showing the following properties:

Property	Value
Field Size	Double
Format	
Decimal Places	Auto
Input Mask	
Caption	
Default Value	
Validation Rule	
Validation Text	
Required	No
Indexed	No

# Components of a Database – Queries

- Used to extract or manipulate data
- Take up much less space than tables

Name	Sex	Age
Chet	M	22
Dianne	F	25
Clint	M	40
Pat	M	18
Debbie	F	30

Question (Query):  
Who is under 20 and male?



Pat	M	18
-----	---	----

# Queries – Common Types

- **Select**
  - Ask questions about the data, make non-permanent calculations of the data
  - Group By function — Allows computation of averages, minimum, maximum, counts, etc. of the data for different field groupings (e.g., maximum hourly ozone value grouped by day)
- **Crosstab**
  - Summarize the data using Group By and display it in a grid format (e.g., maximum hourly ozone value by day by site)
- **Update\***
  - Change data in the table to new values using calculations or assigning a set value for each record
- **Append\***
  - Add new data to an existing table
- **Delete\***
  - Delete existing data from tables based on given criteria
- **Make-Table\***
  - Put Select query results into a new table in the database

**\*THESE ACTION QUERIES CANNOT BE UNDONE!**

# Queries – Select

**SFC : Table**

	Site	Date GMT	Time GMT	Date LST	Time LST	WD	WS (m/s)	Temp (C)	DPTemp (C)	Precip	Clouds	SLP	Altimeter
	KJAD	1/1/1999	00:00:00	12/31/1998	18:00:00	0	0	-8	-9	0	SCT	1020.5	30.12
	KJAD	1/1/1999	01:00:00	12/31/1998	19:00:00	0	0	-8	-10	-999	CLR	1020.2	30.11
	KJAD	1/1/1999	02:00:00	12/31/1998	20:00:00	0	0	-9	-11	-999	CLR	1020.5	30.12
	KJAD	1/1/1999	03:00:00	12/31/1998	21:00:00	0	0	-10	-12	0	SCT	1020.7	30.13
▶	KJAD	1/1/1999	04:00:00	12/31/1998	22:00:00	0	0	-11	-13	-999	SCT	1020.5	30.12
	KJAD	1/1/1999	05:00:00	12/31/1998	23:00:00	200	2.04	-11	-13	-999	SCT	1021	30.14
	KJAD	1/1/1999	06:00:00	1/1/1999	00:00:00	0	0	-10	-11	0	SCT	1020	30.11
	KJAD	1/1/1999	07:00:00	1/1/1999	01:00:00	0	0	-11	-13	-999	SCT	1020.5	30.12
	KJAD	1/1/1999	08:00:00	1/1/1999	02:00:00	0	0	-12	-14	-999	SCT	1021	30.14
	KJAD	1/1/1999	09:00:00	1/1/1999	03:00:00	0	0	-9	-11	0	BKN	1021.1	30.14
	KJAD	1/1/1999	10:00:00	1/1/1999	04:00:00	0	0	-9	-11	-999	OVC	1021	30.14

Record: 5 of 26085

**DailyPrecip : Select Query**

SFC

Site  
Date GMT  
Time GMT  
Date LST

Field: Date LST  
Table: SFC  
Sort: SFC  
Show: ☒  
Criteria: ☒  
or: ☒ <-999

**DailyPrecip : Select Query**

	Site	Date LST	Precip
	KJAD	1/1/1999	0
	KJAD	1/1/1999	0
	KJAD	1/2/1999	0
	KJAD	1/2/1999	0
	KJAD	1/2/1999	0
	KJAD	1/2/1999	0
▶	KJAD	1/2/1999	0
	KJAD	1/2/1999	0.01
	KJAD	1/3/1999	0.09
	KJAD	1/3/1999	0.15
	KJAD	1/3/1999	0.2
	KJAD	1/3/1999	0
	KJAD	1/3/1999	0

Record: 15

- Returns all individual records with valid precipitation data
- Returns 8,646 rows out of 26,085 from the original SFC table

# Queries - Group By Select

SFC : Table

	Site	Date GMT	Time GMT	Date LST	Time LST	WD	WS (m/s)	Temp (C)	DPTemp (C)	Precip	Clouds	SLP	Altimeter
	KIAD	1/1/1999	00:00:00	12/31/1998	18:00:00	0	0	-8	-9	0	SCT	1020.5	30.12
	KIAD	1/1/1999	01:00:00	12/31/1998	19:00:00	0	0	-8	-10	-999	CLR	1020.2	30.11
	KIAD	1/1/1999	02:00:00	12/31/1998	20:00:00	0	0	-9	-11	-999	CLR	1020.5	30.12
	KIAD	1/1/1999	03:00:00	12/31/1998	21:00:00	0	0	-10	-12	0	SCT	1020.7	30.13
	KIAD	1/1/1999	04:00:00	12/31/1998	22:00:00	0	0	-11	-13	-999	SCT	1020.5	30.12
	KIAD	1/1/1999	05:00:00	12/31/1998	23:00:00	200	2.04	-11	-13	-999	SCT	1021	30.14
	KIAD	1/1/1999	06:00:00	1/1/1999	00:00:00	0	0	-10	-11	0	SCT	1020	30.11
	KIAD	1/1/1999	07:00:00	1/1/1999	01:00:00	0	0	-11	-13	-999	SCT	1020.5	30.12
	KIAD	1/1/1999	08:00:00	1/1/1999	02:00:00	0	0	-12	-14	-999	SCT	1021	30.14
	KIAD	1/1/1999	09:00:00	1/1/1999	03:00:00	0	0	-9	-11	0	BKN	1021.1	30.14
	KIAD	1/1/1999	10:00:00	1/1/1999	04:00:00	0	0	-9	-11	-999	OVC	1021	30.14

Record: 14 of 26085

DailyPrecip : Select Query

SFC

Site  
Date GMT  
Time GMT  
Date LST

Field:	Site	Date LST	Precip	Precip
Table:	SFC	SFC	SFC	SFC
Total:	Group By	Group By	Sum	Where
Sort:				
Show:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Criteria:				<>-999
or:				

DailyPrecip : Select Query

Site	Date LST	SumOfPrecip
KIAD	12/31/1998	0
KIAD	1/1/1999	0
KIAD	1/2/1999	0.01
KIAD	1/3/1999	0.44
KIAD	1/4/1999	0
KIAD	1/5/1999	0
KIAD	1/6/1999	0
KIAD	1/7/1999	0
KIAD	1/8/1999	0.18
KIAD	1/9/1999	0.03
KIAD	1/10/1999	0
KIAD	1/11/1999	0
KIAD	1/12/1999	0

Record: 13 of 1

- Returns one record per day with the daily sum of precipitation data
- Returns 1,097 records

# Queries – Crosstab Example

SFC : Table

Site	Date GMT	Time GMT	Date LST	Time LST	WD	WS (m/s)	Temp (C)	DPTemp (C)	Precip	Clouds	SLP	Altimeter
KJAD	1/1/1999	00:00:00	12/31/1998	18:00:00	0	0	-8	-9	0	SCT	1020.5	30.12
KJAD	1/1/1999	01:00:00	12/31/1998	19:00:00	0	0	-8	-10	-999	CLR	1020.2	30.11
KJAD	1/1/1999	02:00:00	12/31/1998	20:00:00	0	0	-9	-11	-999	CLR	1020.5	30.12
KJAD	1/1/1999	03:00:00	12/31/1998	21:00:00	0	0	-10	-12	0	SCT	1020.7	30.13
KJAD	1/1/1999	04:00:00	12/31/1998	22:00:00	0	0	-11	-13	-999	SCT	1020.5	30.12
KJAD	1/1/1999	05:00:00	12/31/1998	23:00:00	200	2.04	-11	-13	-999	SCT	1021	30.14
KJAD	1/1/1999	06:00:00	1/1/1999	00:00:00	0	0	-10	-11	0	SCT	1020	30.11
KJAD	1/1/1999	07:00:00	1/1/1999	01:00:00	0	0	-11	-13	-999	SCT	1020.5	30.12
KJAD	1/1/1999	08:00:00	1/1/1999	02:00:00	0	0	-12	-14	-999	SCT	1021	30.14
KJAD	1/1/1999	09:00:00	1/1/1999	03:00:00	0	0	-9	-11	0	BKN	1021.1	30.14
KJAD	1/1/1999	10:00:00	1/1/1999	04:00:00	0	0	-9	-11	-999	OVC	1021	30.14

Record: 5 of 26095

Query3\_Crosstab : Crosstab Query

Month	12:00:00 AM	3:00:00 AM	6:00:00 AM	9:00:00 AM	12:00:00 PM	3:00:00 PM	6:00:00 PM	9:00:00 PM
1	4	8	10	10	10	6	5	5
2	5	6	4	10	5	5	6	5
3	9	6	8	8	10	10	12	11
4	4	2	10	5	8	9	6	7
5	6	6	5	6	4	5	6	3
6	4	3	4	5	3	5	7	3
7	4	3	6	2	3	8	11	8
8	4	1	3	2	2	7	7	1
9	11	8	8	8	9	6	12	10
10	1	2	4	2	1	2	4	4
11	4	3	1	3	4	4	6	2
12	8	5	8	6	5	4	4	5

Record: 10 of 12

Reports of  
measurable  
rain for each  
month by hour



# Components of a Database – Forms and Reports

- Tools for viewing and/or entering data outside the table view
- Both tools are linked to tables or queries

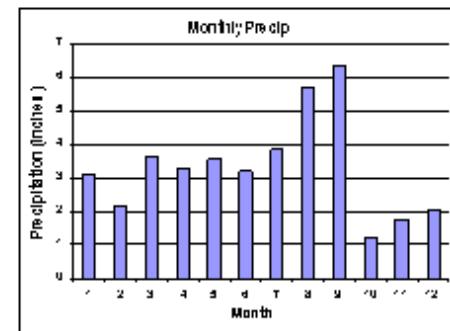
**Surface Entry**

Site	KIAD	Precip	0
Date LST	12/31/1998	Clouds	SCT
Time LST	18:00:00	SLP	1020.5
WD	0	Altimeter	30.12
WS (m/s)	0		
Temp (C)	-8		
DPTemp (C)	-9		

Record: 1 of 26085

*Monthly Precip*

<i>Month</i>	<i>SumOfPrecip</i>
1	3.12
2	2.13
3	3.65
4	3.29
5	3.56
6	3.2
7	3.86
8	5.71
9	6.39
10	1.22
11	1.76



Wednesday, February 04, 2004

Page 1 of 2



# Populating a Database

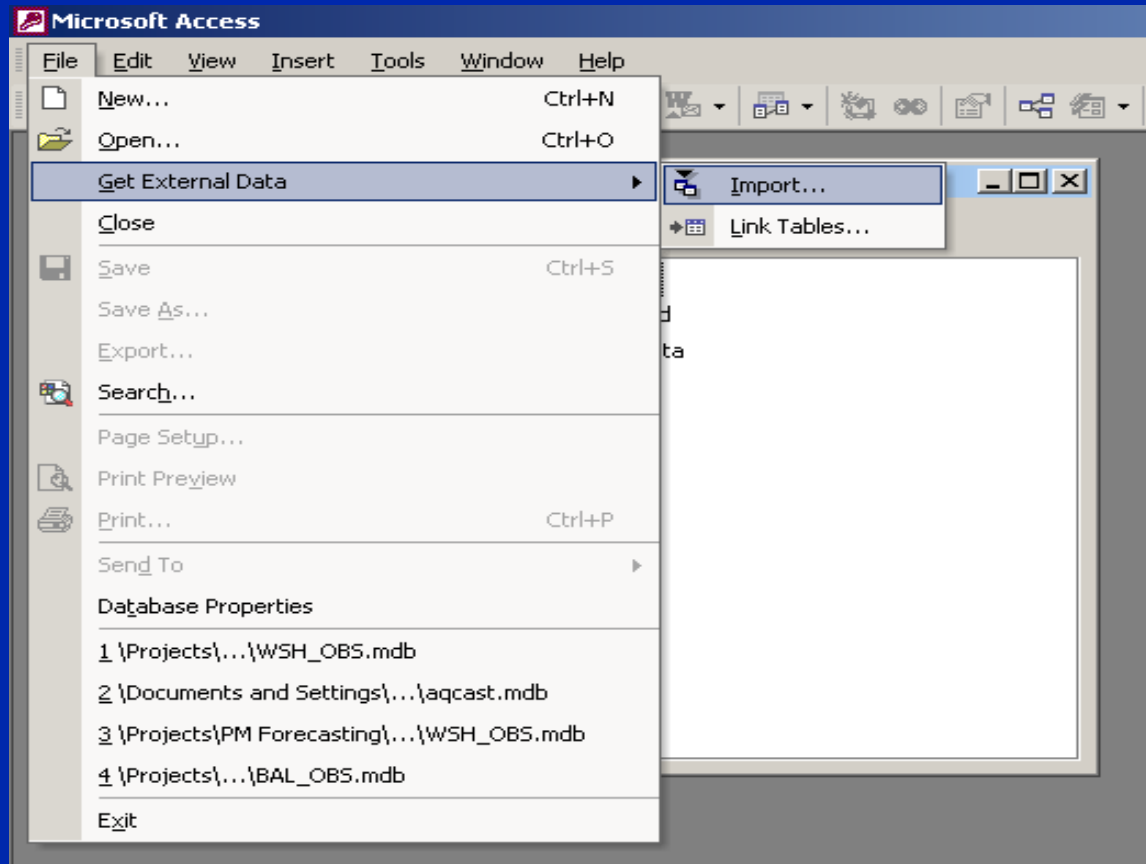
- What needs to be done
- Some key issues
  - Time stamps
  - Missing data
  - Duplicates
- How to resolve issues

# Populating – Step 1: Importing Data

- Use the Import Text Wizard
  - Wizards assist in performing actions within the database that would otherwise be complex
  - Be sure to install wizards
- Issues
  - Formats
  - Variable types
  - Truncating data because of improper type assignment
  - Assigning primary key(s)

# Importing Data – Example (1 of 4)

Select *File*, *Get External Data*, and *Import*



# Importing Data – Example (2 of 4)

## Select data format

**Import Text Wizard**

Your data seems to be in a 'Delimited' format. If it isn't, choose the format that more correctly describes your data.

☒ Delimited - Characters such as comma or tab separate each field

☐ Fixed Width - Fields are aligned in columns with spaces between each field

Sample data from file: C:\PROJECTS\ACCESS BROWN BAG\EPA CONF ACCESS COURSE\WS

1	"UCITYID", "DUTC", "Previous_Day_24hrPM25", "Next_Day_2
2	162, 1/15/1999 00:00:00, , 15.00, 12.00
3	162, 1/16/1999 00:00:00, 12.00, 22.00, 15.00
4	162, 1/17/1999 00:00:00, 15.00, 14.00, 22.00
5	162, 1/18/1999 00:00:00, 22.00, 8.00, 14.00
6	162, 1/19/1999 00:00:00, 14.00, 13.00, 8.00

Advanced... Cancel < Back Next > Finish

# Importing Data – Example (3 of 4)

## Assign data types

- Beware of truncating data with incorrect assignments from Access defaults
- Use smallest data type that will accommodate all data (see next page)

You can specify information about each of the fields you are importing. Select fields in the area below. You can then modify field information in the 'Field Options' area.

Field Options

Field Name: "Previous\_Day\_24hrPM25" Data Type: Text

Indexed: No ☐ Do not import field (Skip)

"UCITYID"	"DUTC"	"Previous Day 24hrPM25"
162	1/15/1999 00:00:00	
162	1/16/1999 00:00:00	12.00
162	1/17/1999 00:00:00	15.00
162	1/18/1999 00:00:00	22.00
162	1/19/1999 00:00:00	14.00
162	1/20/1999 00:00:00	8.00

Advanced... Cancel < Back Next > Finish

# Importing Data – Data Types (1 of 2)

## General data types

Type	Description	Size
Text	(Default) Text or combinations of text and numbers, as well as numbers that don't require calculations, such as phone numbers.	Up to 255 characters
Memo	Lengthy text or combinations of text and numbers.	Up to 65,535 characters
Number	Numeric data used in mathematical calculations.	1, 2, 4, or 8 bytes (see Field Size table).
Date/Time	Date and time values for the years 100 through 9999.	8 bytes.
Currency	Currency values and numeric data used in mathematical calculations involving data with one to four decimal places.	8 bytes. Accurate to 15 digits on the left side of the decimal separator and to 4 digits on the right side.
AutoNumber	A unique sequential (incremented by 1) number or random number assigned whenever a new record is added to a table.	4 bytes
Yes/No	Yes and No values and fields that contain only one of two values (Yes/No, True/False, or On/Off).	1 bit.
OLE Object	An object linked to or embedded in a Microsoft Access table.	Up to 1 gigabyte (limited by available disk space)
Hyperlink	Text or combinations of text and numbers stored as text and used as a hyperlink address.	Each part of the three parts of a Hyperlink data type can contain up to 2048 characters.

# Importing Data – Data Types (2 of 2)

## Numeric data types

Type	Description	Decimal Precision	Size
Byte	Stores whole numbers from 0 to 255.	None	1 byte
Decimal	Stores numbers from $-9.9\text{e}38$ through $9.9\text{e}38$ (.adp)	28	12bytes
	Stores numbers from $-9.9\text{e}28$ through $9.9\text{e}28$ (.mdb)		
Integer	Stores numbers from $-32,768$ to $32,767$ (no fractions).	None	2 bytes
Long Integer	(Default) Stores numbers from $-2,147,483,648$ to $2,147,483,647$ (no fractions).	None	4 bytes
Single	Stores numbers from $-3.402823\text{E}38$ to $-1.401298\text{E}-45$ for negative values and from $1.401298\text{E}-45$ to $3.402823\text{E}38$ for positive values.	7	4 bytes
Double	Stores numbers from $-1.79769313486231\text{E}308$ to $-4.94065645841247\text{E}-324$ for negative values and from $4.94065645841247\text{E}-324$ to $1.79769313486231\text{E}308$ for positive values.	15	8 bytes
Replication ID	Globally unique identifier (GUID)	N/A	16 bytes

# Importing Data – Example (4 of 4)

- Assign primary key if it is only one field  
*or*
- Select no primary key and assign key after data is imported

Microsoft Access recommends that you define a primary key for your new table. A primary key is used to uniquely identify each record in your table. It allows you to retrieve data more quickly.

☐ Let Access add primary key.

☒ Choose my own primary key. **"DUTC"**

☐ No primary key.

"UCITYID"	"DUTC"	"Previous Day 24hrPM25"
162	1/15/1999 00:00:00	
162	1/16/1999 00:00:00	12.00
162	1/17/1999 00:00:00	15.00
162	1/18/1999 00:00:00	22.00
162	1/19/1999 00:00:00	14.00
162	1/20/1999 00:00:00	8.00

Advanced... Cancel < Back Next > Finish



## Populating – Step 2: Keying Data

- Prevents duplicate records by not allowing them
- Key data fields that make the record unique (for example, Date and Time)

Duplicate



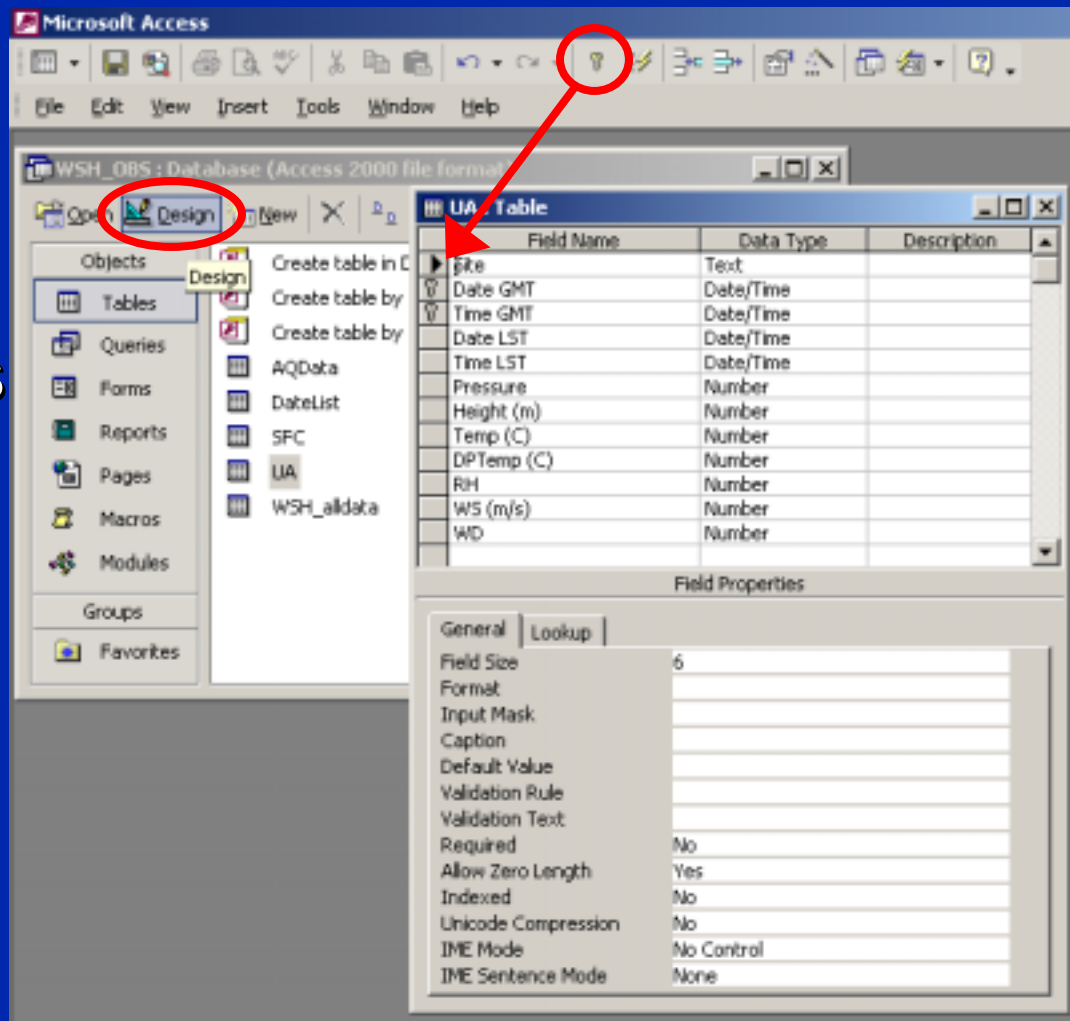
Date	Time (LST)	Ozone (ppb)	Temperature (F)
1/1/2002	12:00	100	90
1/1/2002	12:00	120	92
1/1/2002	13:00	90	96
1/1/2002	14:00	120	98
1/1/2002	15:00	120	98

# Keying Data – How

- Import  
*or*
- If data is already in database, run “find duplicates” query and remove existing duplicates, then set key in table design view

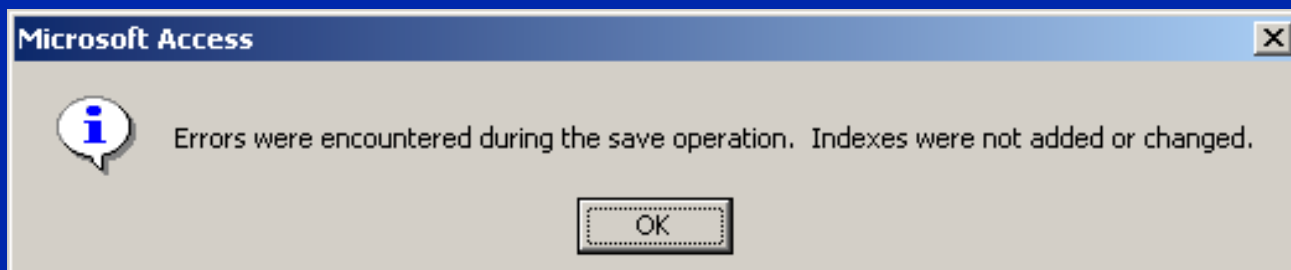
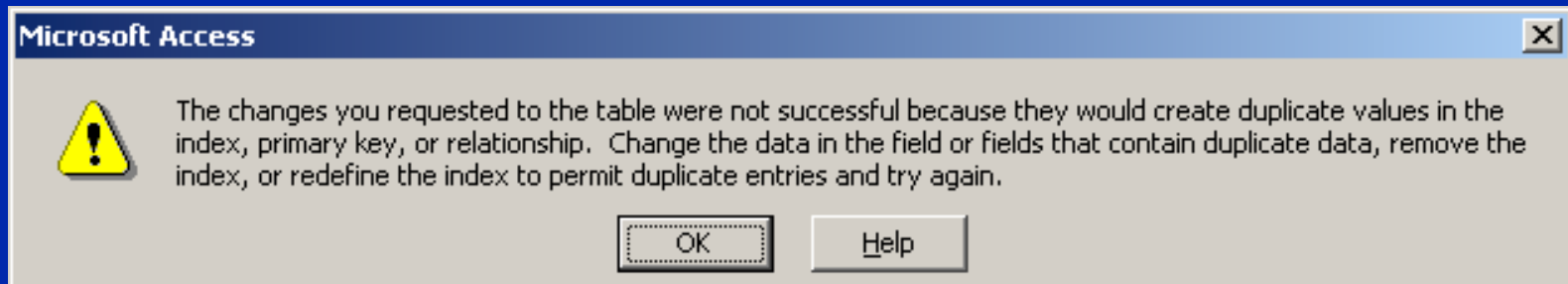
# Keying Data – Example (1 of 3)

- Open table in design view
- Highlight fields to be set as keys
- Push the Key button
- Saves when database is closed if no duplicates exist



# Keying data – Example (2 of 3)

- If duplicates exist, the following errors appear:

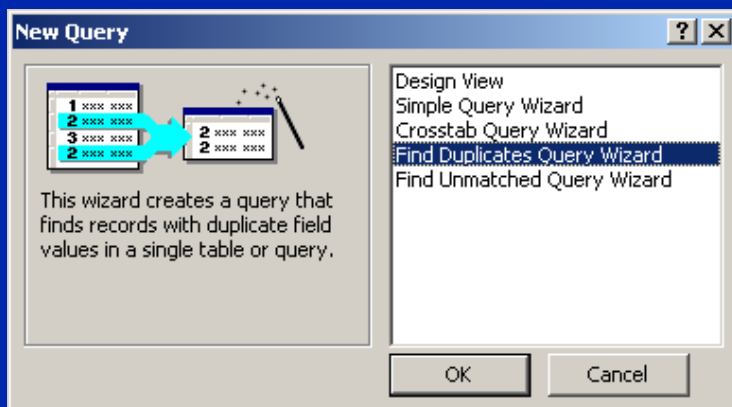


- Remove the keys by clicking the key button again, then close the table and run a “find duplicates” query

# Keying Data – Example (3 of 3)

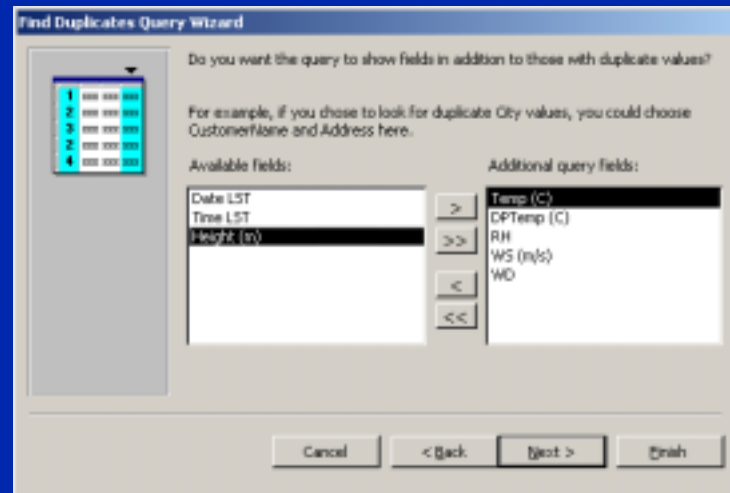
## Find Duplicates Query Wizard

1.



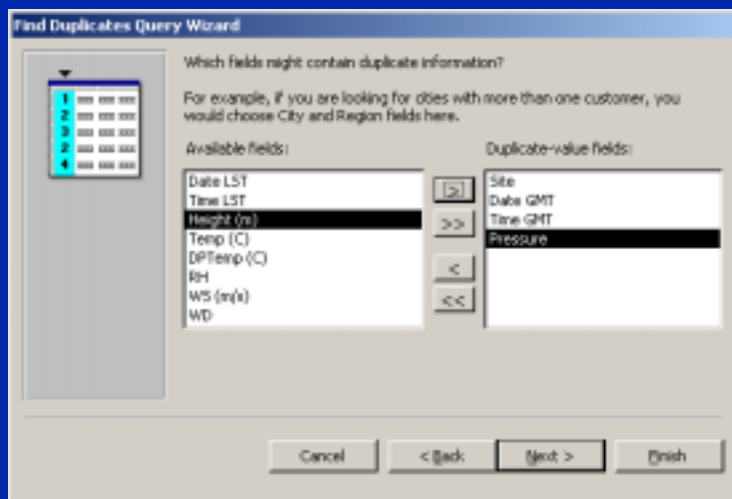
3.

## Select other fields to view



## Select fields with duplicates

2.



4.

Find duplicates for UA : Select Query

	Site	Date GMT	Time GMT	Pressure	Height (m)	Temp (C)	DPTemp (C)	RH	WS (m/s)	WD
	KIAD	7/25/1999	12:00:00	1000	85	18.8	18.8	100	1.55	20
	KIAD	7/25/1999	12:00:00	1000	0	18.8	18.8	100	1.55	20
	KIAD	7/26/1999	12:00:00	1000	-999	-999	-999	-999	-999	-999
	KIAD	7/26/1999	12:00:00	1000	81	18.2	18.2	100	1.04	290

Record: 1 of 4

# Populating – Step 3: Checking Data

- Check for outliers
  - Look at the minimum and maximum values for each field; are they reasonable?
  - Check rate of change between records at each extreme.
- Time stamps
  - Has all data been properly matched by time?
  - Time series plots can help identify problems shifting from UTC to LST.
- Missing data
  - Is the same identifier used for each field? I.e., –999.
- Units
  - Are units consistent among different data sets? I.e., m/s or knots for wind speeds.
- Validation codes
  - Are validation codes consistent among different data sets?
  - Do the validation codes match the data values? I.e., are data values of –999 flagged as missing?

# Using Databases

- Queries
- SYSTAT
- Export
- Forecast tools

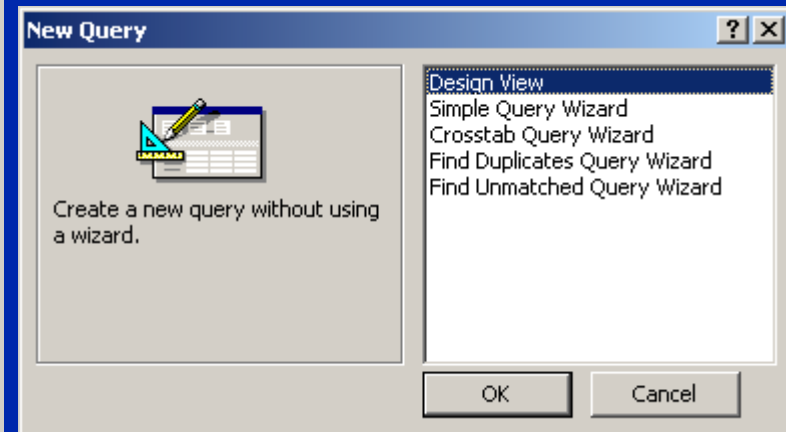
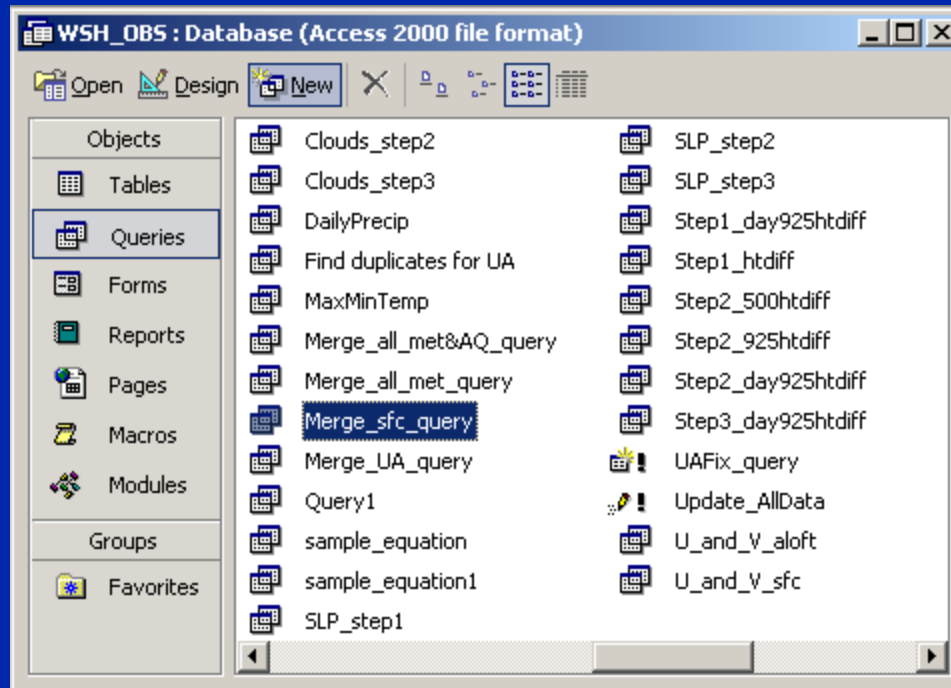
# Using Databases – Queries

- Queries are run using Structured Query Language (SQL) code
- Query builder simplifies the process by writing the code for the user
- To write a query,
  - Select Query in Access
  - Select New
  - Select table(s) to query
  - Select data in table to query
  - Select criteria for query
  - Run query



# Queries – Writing (1 of 6)

## Select Queries, New, and Design View in Access



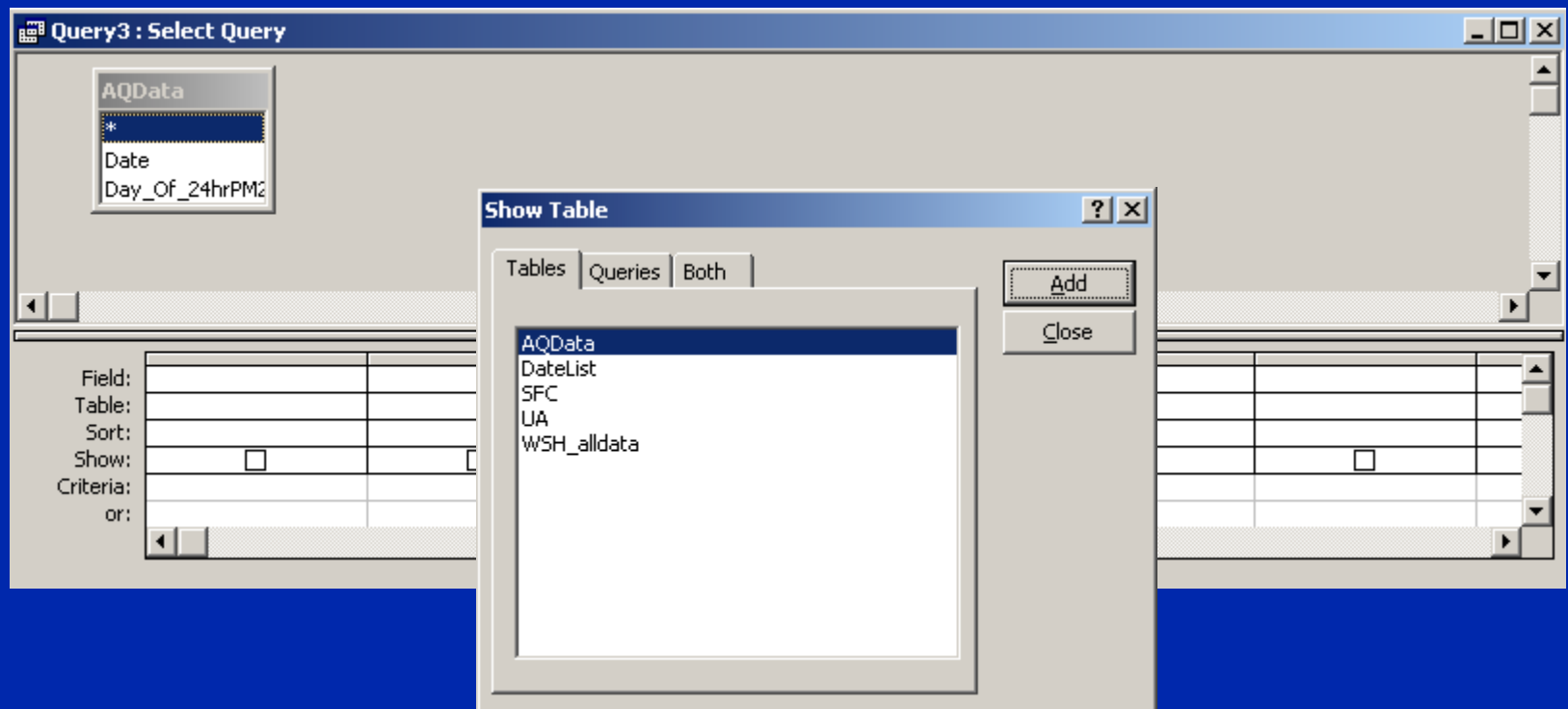
# Queries – Writing (2 of 6)

Select table(s) to query

- Click on Add

*or*

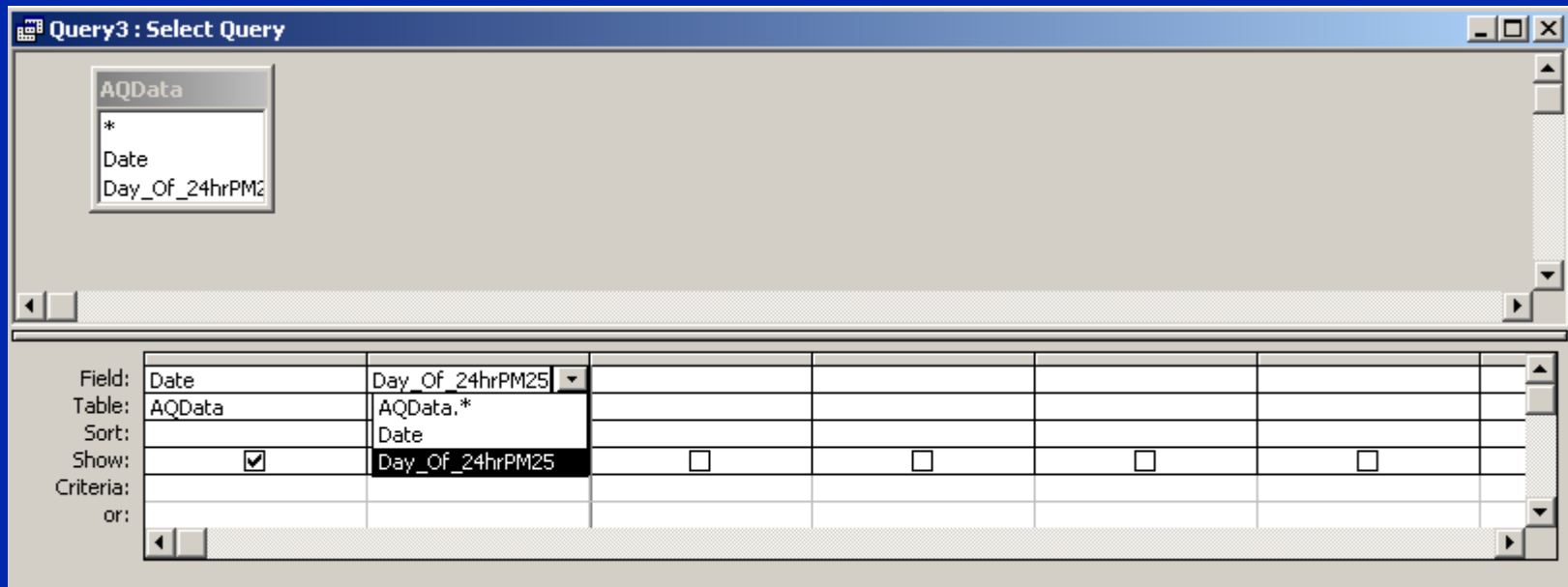
- Double-click on selected table



# Queries – Writing (3 of 6)

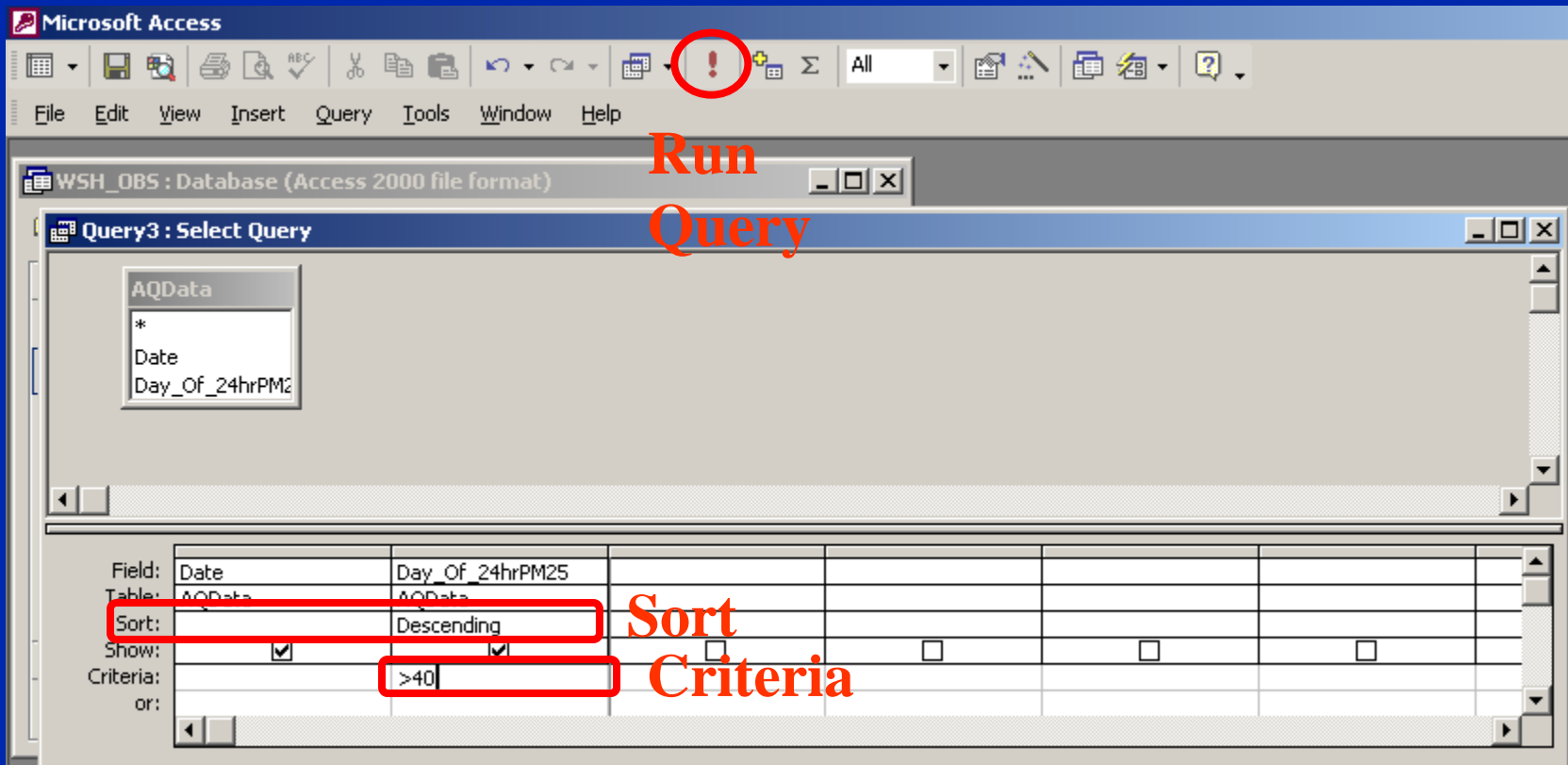
Select data in table(s) to query

- Double-click on selected field *OR*
- Click the field once, hold the button down, and drag the field to the field box *OR*
- Click in blank field box and use the drop down menu to select a field

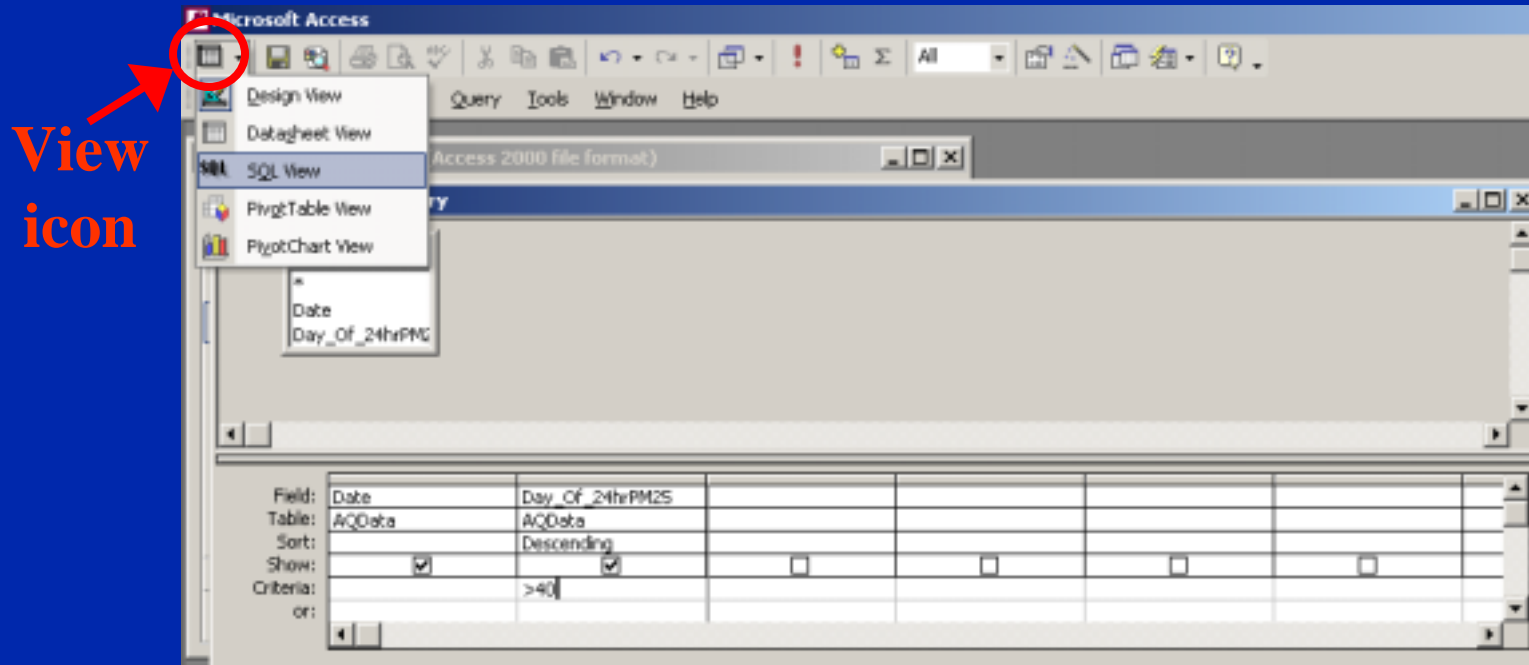


# Queries – Writing (4 of 6)

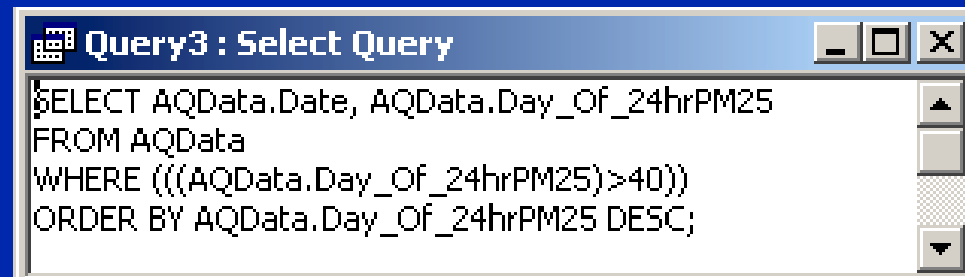
- Select criteria for query
- Select sort order
- Run query



# Queries – Writing (5 of 6)

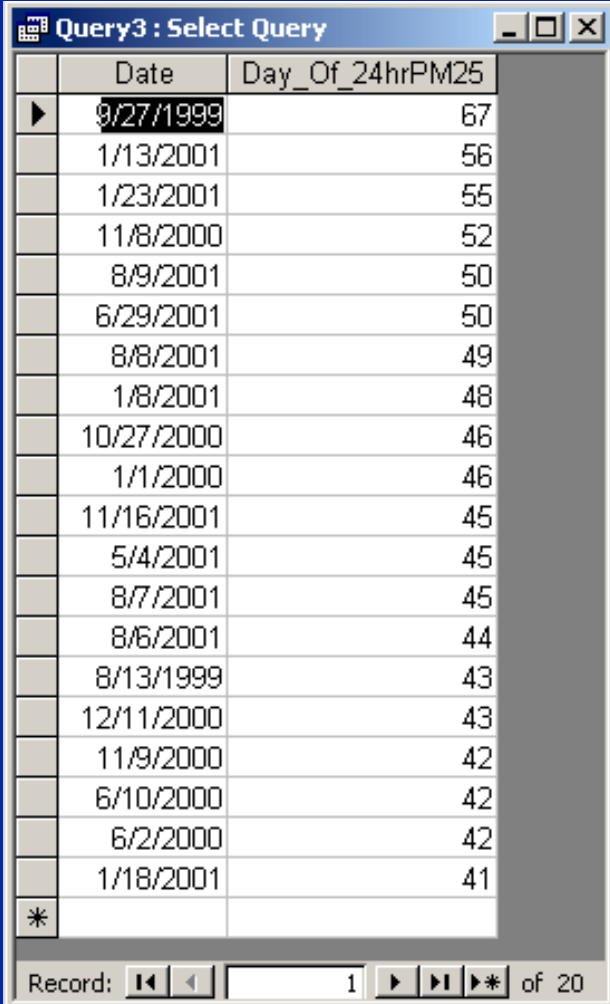


Query builder is writing SQL code for the user. To view the code, click on the view icon in the upper-left corner and select SQL View.



# Queries – Writing (6 of 6)

Results: 20 records meet the selected criteria (1,067 in the original table)



Date	Day_Of_24hrPM25
9/27/1999	67
1/13/2001	56
1/23/2001	55
11/8/2000	52
8/9/2001	50
6/29/2001	50
8/8/2001	49
1/8/2001	48
10/27/2000	46
1/1/2000	46
11/16/2001	45
5/4/2001	45
8/7/2001	45
8/6/2001	44
8/13/1999	43
12/11/2000	43
11/9/2000	42
6/10/2000	42
6/2/2000	42
1/18/2001	41

# Queries – Merging Data

After importing different data tables, you may need to merge tables (or queries) into one table for tool development

## Issues:

- Join types
- Master date/time table
- Formats/units (e.g., dates/times may appear identical when they are not)

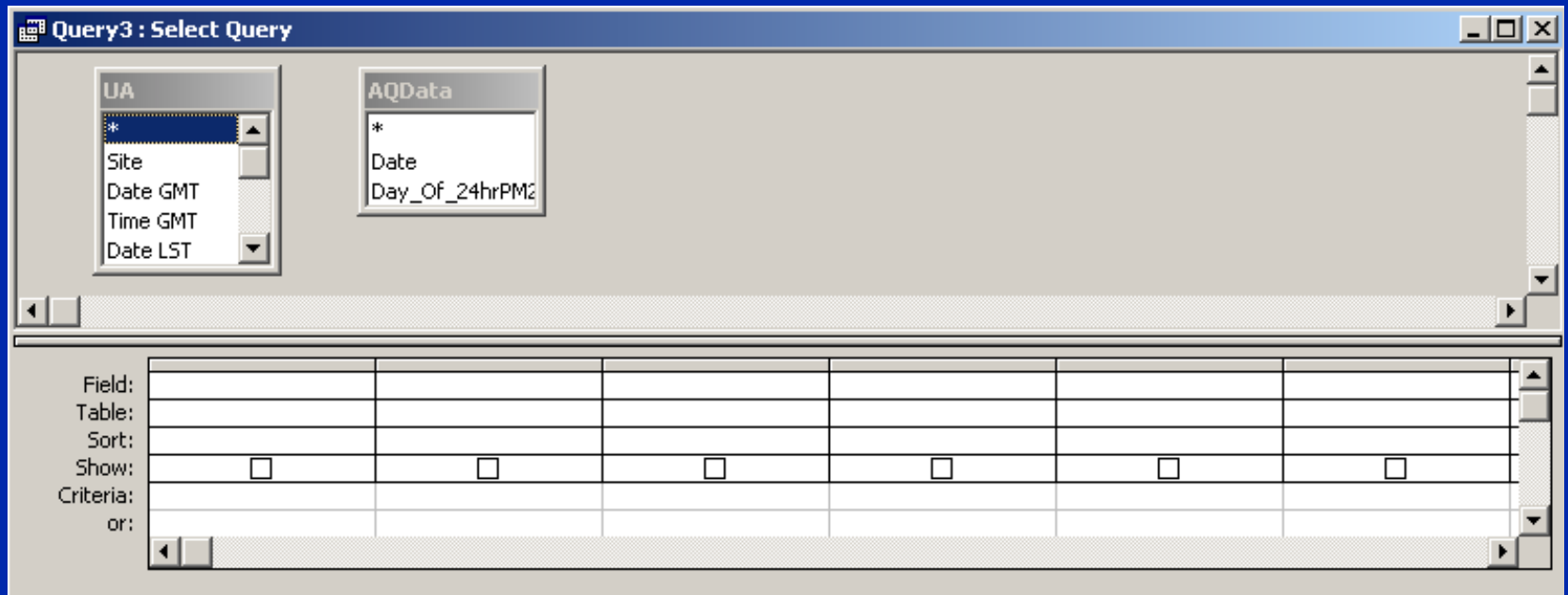
# Merging Data – Example (1 of 9)

- Open new query
- Select tables to join
- Determine which field(s) to join
- Make sure fields have same units and formats
- Click on first field in first table
- Holding the mouse button down, drag it to the matching field in the second table
- Release the mouse and a join line will appear.
- If tables in a query are not joined to one another, Access does not know which records are associated with other records, so it displays every combination of records between the two tables. Therefore, if each table had 10 records in it, the query's results will contain 100 records (10X10).



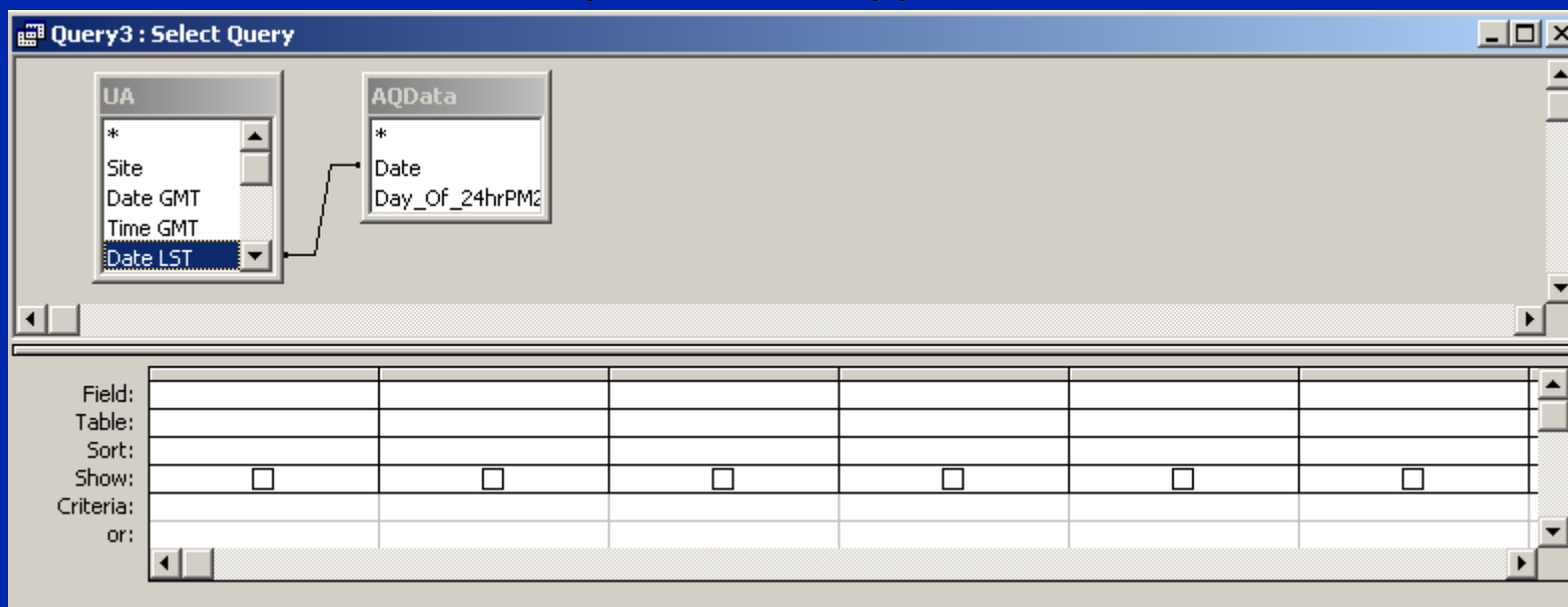
# Merging Data – Example (2 of 9)

- Open new query
- Select tables to join



# Merging Data – Example (3 of 9)

- Determine which field(s) to join, e.g.,
  - Join on Date
  - Date in AQData is in LST, so join has to be with Date LST in UA, not Date GMT
- Click on first field in first table
- Holding the mouse button down, drag it to the matching field in the second table
- Release the mouse and a join line will appear.



# Merging Data – Example (4 of 9)

## Select fields

Query3 : Select Query

UA

- Temp (C)
- DPTemp (C)
- RH
- WS (m/s)
- WD

AQData

- \*
- Date
- Day\_Of\_24hrPM2

Fields originated in these tables

Field:	Site	Date	Day_Of_24hrPM25	Pressure	Height (m)	Temp (C)	DPTemp (C)	RH	WS (m/s)	WD
Table:	UA	AQData	AQData	UA	UA	UA	UA	UA	UA	UA
Sort:										
Show:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Criteria:										
or:										

Query3 : Select Query

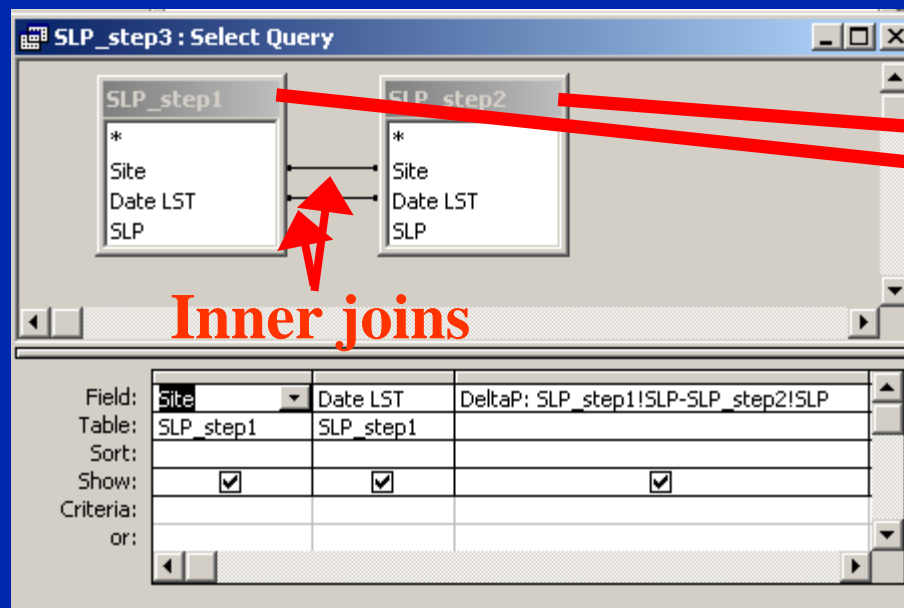
	Site	Date	Day_Of_24hrPM25	Pressure	Height (m)	Temp (C)	DPTemp (C)	RH	WS (m/s)	WD
	KIAD	1/17/1999	22	300	9290	-45.5	-49.9	60.63	37.82	240
	KIAD	1/17/1999	22	250	10480	-55.5	-59.8	58.01	43.52	235
	KIAD	1/17/1999	22	200	11900	-57.3	-70.3	17.08	36.27	255
	KIAD	1/18/1999	14	1004	0	6	6	100	0	0
	KIAD	1/18/1999	14	1000	119	6	6	100	2.07	20
	KIAD	1/18/1999	14	925	763	10.6	10.6	100	21.24	195
	KIAD	1/18/1999	14	850	1466	8.8	4.3	73.37	20.21	215
	KIAD	1/18/1999	14	700	3041	-2.5	-2.5	100	18.65	230

Record: 3 of 19748

# Merging Data – Example (5 of 9)

## Two types of joins

- Inner (default): Returns records with matching values in the join fields
- Outer: Returns all records from one table and those that match from the other table



SLP\_step1: Select Q...

Site	Date LST	SLP
KIAD	3/6/1999	1019.7
KIAD	3/7/1999	1025.8
KIAD	3/8/1999	1037.5
KIAD	3/9/1999	1028.7
KIAD	3/10/1999	1013.9

Record: 1

SLP\_step2: Select Q...

Site	Date LST	SLP
KIAD	3/5/1999	1026.8
KIAD	3/6/1999	1010.9
KIAD	3/7/1999	1033.3
KIAD	3/9/1999	1017.5
KIAD	3/10/1999	1013.2

Record: 75

SLP\_step3: Select Query

Site	Date LST	DeltaP
KIAD	3/5/1999	0.8
KIAD	3/6/1999	0.000000000
KIAD	3/7/1999	-7.5
KIAD	3/9/1999	11.2
KIAD	3/10/1999	0.7
KIAD	3/11/1999	3.4

Record: 10

Tip – use a master date table

# Merging Data – Example (6 of 9)

Right click on join lines to set properties

**Inner joins (default)**

**Join Properties**

Field:	Site	Date LST	MaxOfTemp(C)	MinOfTemp(C)	Avg
Table:	DailyPrecip	DateList	MaxMinTemp	MaxMinTemp	Avg
Sort:					
Show:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Criteria:					
or:					

Left Table Name: DateList  
Right Table Name: AvgWSWD6a6p  
Left Column Name: Date LST  
Right Column Name: Date LST

☒ 1: Only include rows where the joined fields from both tables are equal.  
☐ 2: Include ALL records from 'DateList' and only those records from 'AvgWSWD6a6p' where the joined fields are equal.  
☐ 3: Include ALL records from 'AvgWSWD6a6p' and only those records from 'DateList' where the joined fields are equal.

OK Cancel New

# Merging Data – Example (7 of 9)

Inner joins caused record on 3/8/99 to be omitted

	Site	Date LST	MaxOfTemp	MinOfTemp	AvgOfDPTemp	SumOfClouds	Clouds_	SumOfPrecip	DeltaP	WS12a6a	WD12a6a	WS6a12p
	KIAD	2/28/1999	7	4	5.076923077	39	3	0.14	5.6000	0.556740	72.28694	1.470052
	KIAD	3/1/1999	7	1	-3.23076923	29	2.2308	0	-5.800	2.277756	247.6208	5.185227
	KIAD	3/2/1999	14	-1	-7	11	0.8462	0	-3.100	2.062686	282.5654	3.844507
	KIAD	3/3/1999	21	3	5.769230769	37	2.8462	0.11	18.2	2.788964	172.2895	5.889929
	KIAD	3/4/1999	5	0	-6.76923077	22	1.6923	0.03	-18.6	8.187181	271.9884	10.23972
	KIAD	3/5/1999	9	-2	-5.53846154	28	2.1538	0	0.8	2.267719	326.1806	1.546066
	KIAD	3/6/1999	13	2	3.692307692	32	2.4615	0	8.8000	3.176335	161.8259	3.483706
	KIAD	3/7/1999	1	-4	-12.6923077	6	0.4615	0	-7.5	9.313072	324.4839	8.783603
	KIAD	3/9/1999	-2	-5	-5.53846154	9	3	0.18	11.2	1.645628	15.32939	1.098962
	KIAD	3/10/1999	2	-4	-4.38461538	36	2.7692	0	0.7	2.38937	10.61582	3.152027
	KIAD	3/11/1999	5	-5	-8.84615385	11	0.8462	0	3.4	4.868526	327.7658	6.342759
	KIAD	3/12/1999	6	-1	-8.30769231	6	0.4615	0	-1	7.03736	319.6908	7.185548
	KIAD	3/13/1999	6	-2	-5.53846154	26	2	0	2.1	5.585649	329.9998	4.707401
	KIAD	3/14/1999	2	1	-0.61538462	36	3	0.21	7.4000	1.085183	20.66792	1.598945
	KIAD	3/15/1999	7	1	-2.69230769	26	2	0.05	-7.100	7.239984	6.292703	7.068222
	KIAD	3/16/1999	13	-1	-5.53846154	10	0.7692	0	5.9	3.880875	309.7272	3.726908

Record: 16 of 993

# Merging Data – Example (8 of 9)

Set all joins to outer joins in the same query

Master date table contains all possible dates

The screenshot displays a database query builder interface. The main window, titled 'Merge\_sfc\_query : Select Query', shows a complex join diagram. A central 'DateList' table is joined to several other tables: 'AvgDaytime...', 'AvgWSWD12...', 'AvgWSWD6a...', 'Clouds\_step3', 'DailyPrecip', 'MaxMinTemp', and 'SLP\_step3'. Red arrows point from the text 'Outer joins' to the join lines connecting 'DateList' to 'AvgDaytime...', 'AvgWSWD12...', 'AvgWSWD6a...', 'Clouds\_step3', 'DailyPrecip', and 'MaxMinTemp'. Another red arrow points from the text 'Master date table contains all possible dates' to the 'DateList' table. A 'Join Properties' dialog box is open, showing the join between 'SLP\_step3' and 'DateList'. The dialog has three radio button options: 1 (Only include rows where the joined fields from both tables are equal.), 2 (Include ALL records from 'SLP\_step3' and only those records from 'DateList' where the joined fields are equal.), and 3 (Include ALL records from 'DateList' and only those records from 'SLP\_step3' where the joined fields are equal.). Option 3 is selected. The 'Left Table Name' is 'SLP\_step3' and the 'Right Table Name' is 'DateList'. The 'Left Column Name' is 'Date LST' and the 'Right Column Name' is 'Date LST'. The 'Join Properties' dialog also has 'OK', 'Cancel', and 'New' buttons.

**Outer joins**

**Join Properties**

Field:	Site	Date LST	MaxOfTemp(C)	MinOfTemp(C)
Table:	DailyPrecip	DateList	MaxMinTemp	MaxMinTemp
Sort:				
Show:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Criteria:				
or:				

**DateList : ...**

Date LST
12/31/1998
1/1/1999
1/2/1999
1/3/1999
1/4/1999
1/5/1999
1/6/1999
1/7/1999
1/8/1999
1/9/1999
1/10/1999
1/11/1999
1/12/1999

Record:

# Merging Data – Example (9 of 9)

Outer joins with master date table properly preserves all data

Site	Date LST	MaxOfT	MinOfT	AvgOfDPT	SumOfClouds	Clouds	SumOfPrecip	DeltaP	WS12a6a
KIAD	2/26/1999	7	-6	-4.07692	15	1.1538	0	-0.100	1.98944537263
KIAD	2/27/1999	11	-6	-4.07692	28	2.1538	0.03	6.6	0.21857075885
KIAD	2/28/1999	7	4	5.076923	39	3	0.14	5.6000	0.55674014027
KIAD	3/1/1999	7	1	-3.23077	29	2.2308	0	-5.800	2.27775645328
KIAD	3/2/1999	14	-1	-7	11	0.8462	0	-3.100	2.06268584411
KIAD	3/3/1999	21	3	5.769231	37	2.8462	0.11	18.2	2.78896395094
KIAD	3/4/1999	5	0	-6.76923	22	1.6923	0.03	-18.6	8.18718090278
KIAD	3/5/1999	9	-2	-5.53846	28	2.1538	0	0.8	2.26771919982
KIAD	3/6/1999	13	2	3.692308	32	2.4615	0	8.8000	3.17633509312
KIAD	3/7/1999	1	-4	-12.6923	6	0.4615	0	-7.5	8.31307172273
KIAD	3/8/1999	2	-8	-14	5	0.4545	0		4.02018034439
KIAD	3/9/1999	-2	-5	-5.53846	9	3	0.18	11.2	1.64562798074
KIAD	3/10/1999	2	-4	-4.38462	36	2.7692	0	0.7	2.38936962716
KIAD	3/11/1999	5	-5	-8.84615	11	0.8462	0	3.4	4.86852566423
KIAD	3/12/1999	6	-1	-8.30769	6	0.4615	0	-1	7.03735993784
KIAD	3/13/1999	6	2	5.53846	26	2	0	3.1	5.59561002012

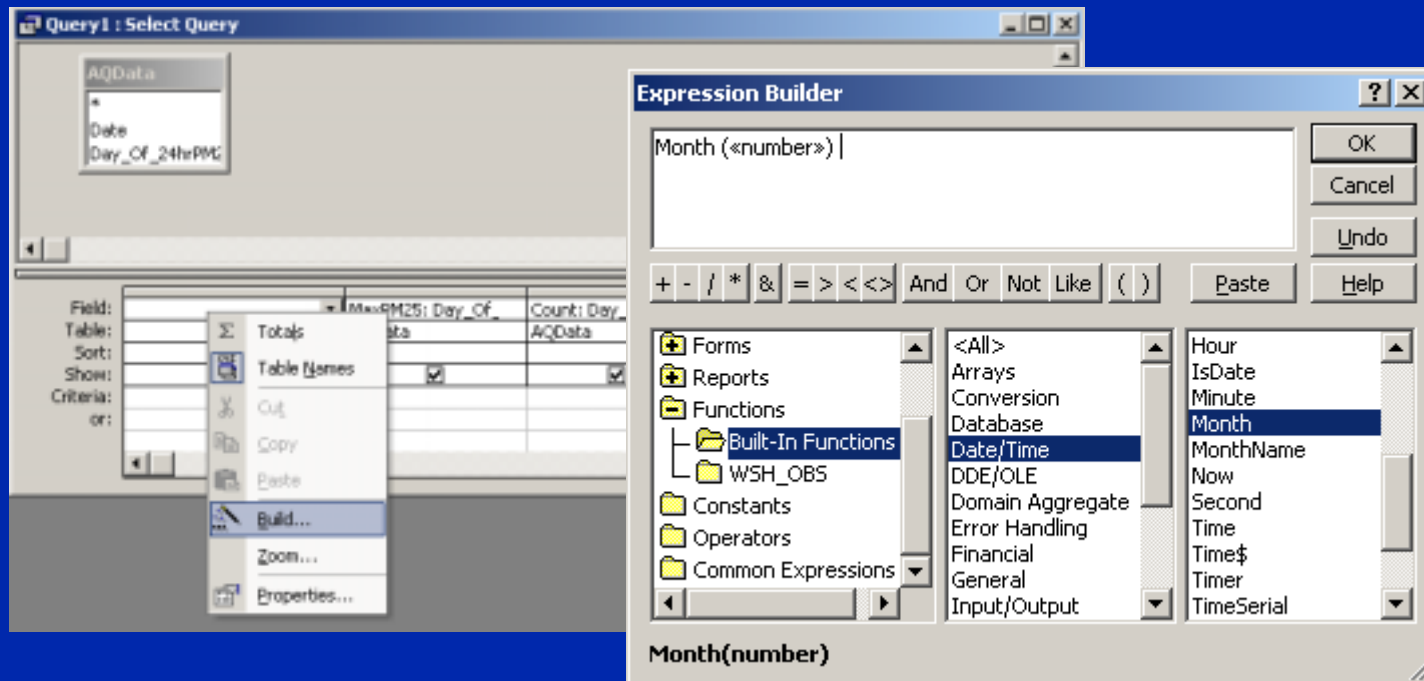
Example: Field is left blank instead of omitting entire record



# Queries – Climatology (1 of 3)

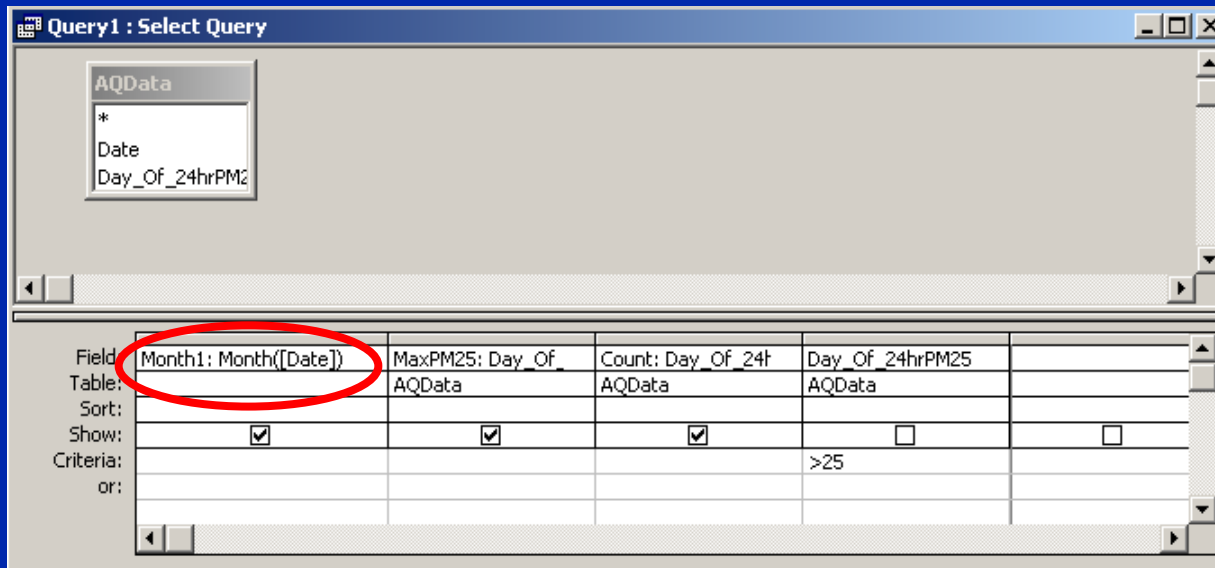
## Create new field (Month1) from existing data

- Right click in blank field and select Build
- Use the Built-in Functions and/or the provided buttons to build your desired computation
- Many similarities to Excel
- The Help button is an excellent resource



# Queries – Climatology (2 of 3)

- Expression appears in Field
- No table will be affiliated with the new field because it is only available to you through running the query



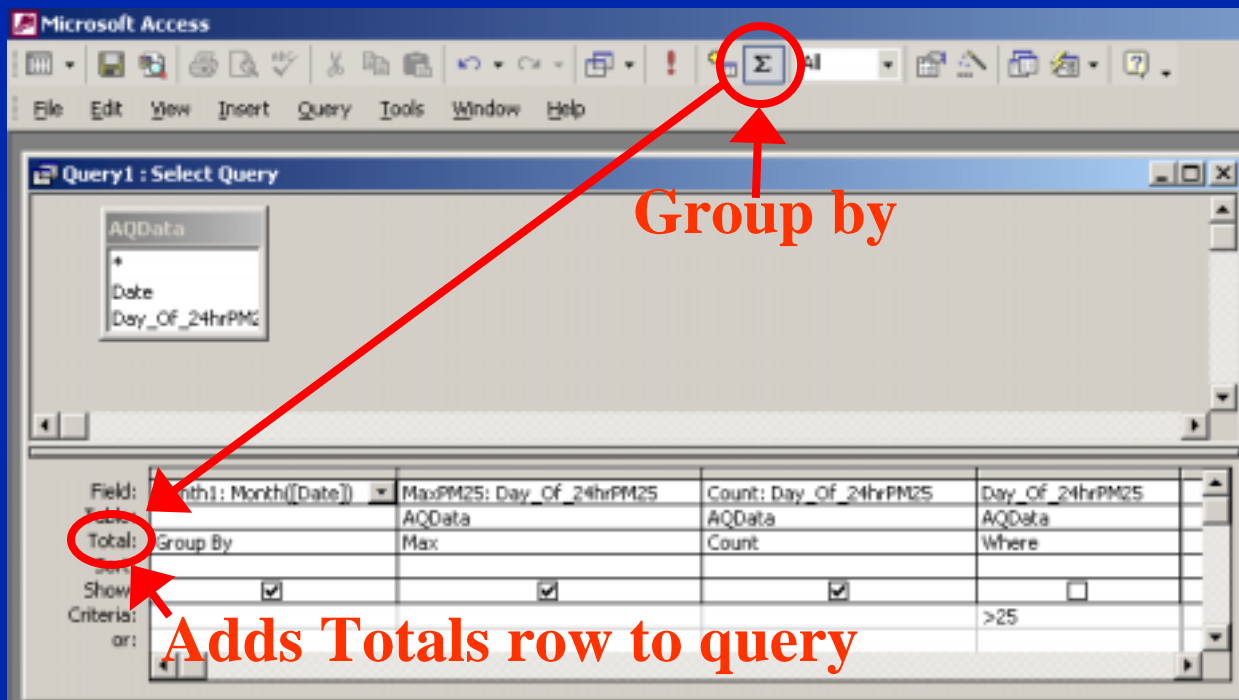
Query1 : Select Query

Month1	MaxPM25	Count
1	32	32
2	26	26
2	27	27
2	27	27
2	31	31
4	38	38
5	38	38
5	31	31
5	33	33
6	35	35
6	38	38
7	35	35
7	39	39
7	39	39
7	29	29
7	35	35
7	34	34
7	37	37
7	35	35
7	30	30
7	37	37

Record: 1 of 177

# Queries – Climatology (3 of 3)

Use Group By functions to obtain counts of high PM<sub>2.5</sub> days by month and the maximum observed PM<sub>2.5</sub> by month

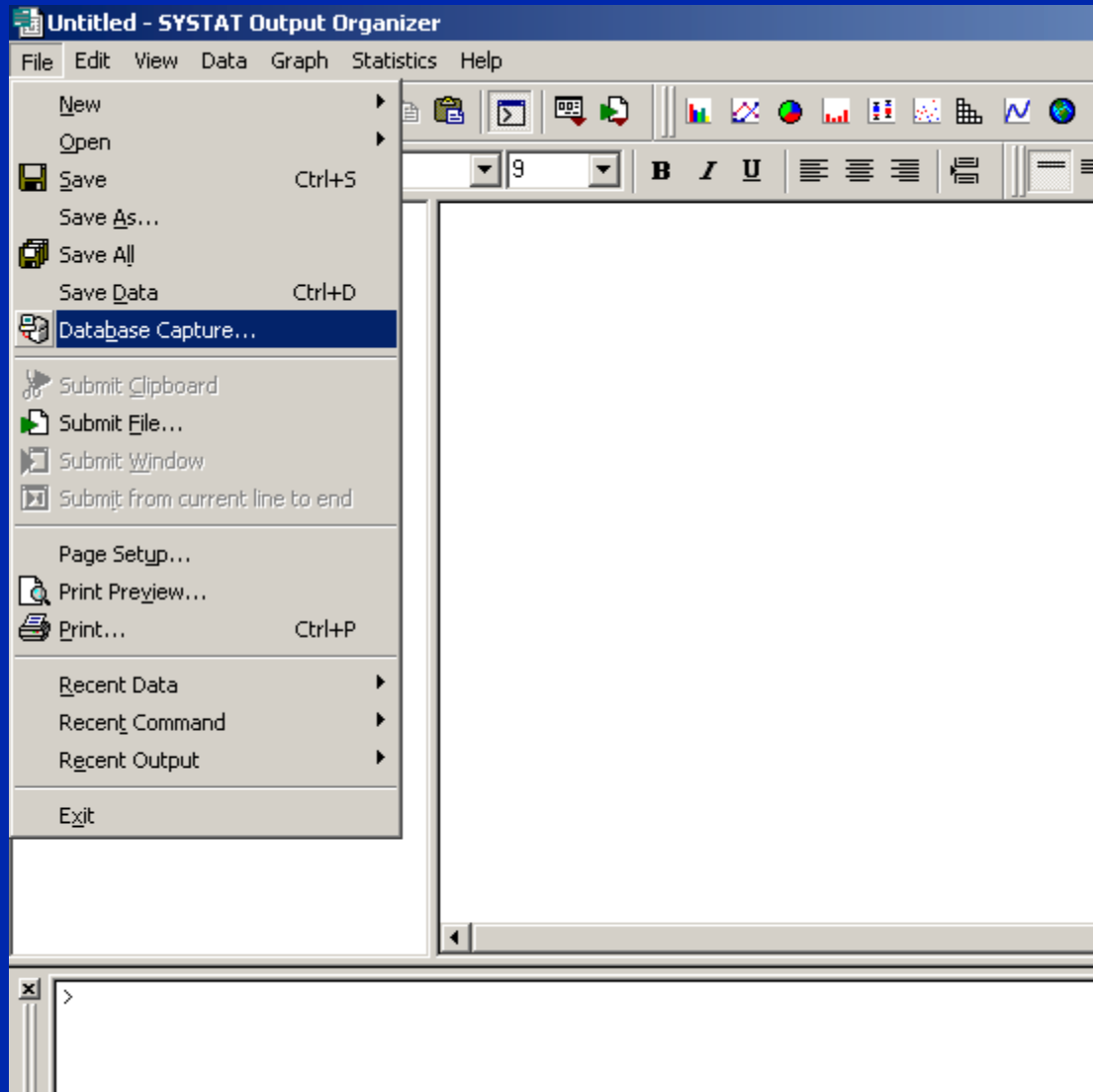


Query1 : Select Query			
	Month1	MaxPM25	Count
▶	1	56	15
	2	32	12
	3	26	1
	4	38	4
	5	45	17
	6	50	21
	7	39	28
	8	50	34
	9	67	8
	10	46	15
	11	52	12
	12	43	10
Record: 1			

# Using Databases – SYSTAT (1 of 4)

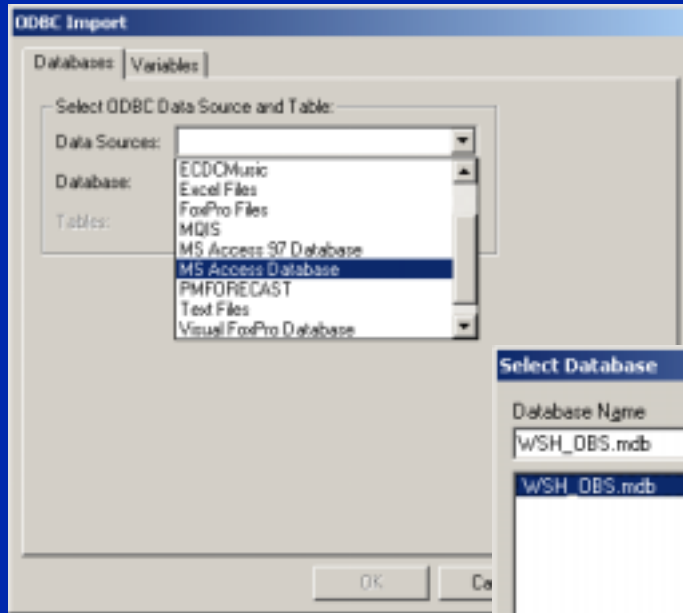
- SYSTAT can read data sets in tables and queries
- Changes made to the data set in SYSTAT cannot be saved to the database
- More details in Session 1B, Part 2

# Using Databases – SYSTAT (2 of 4)

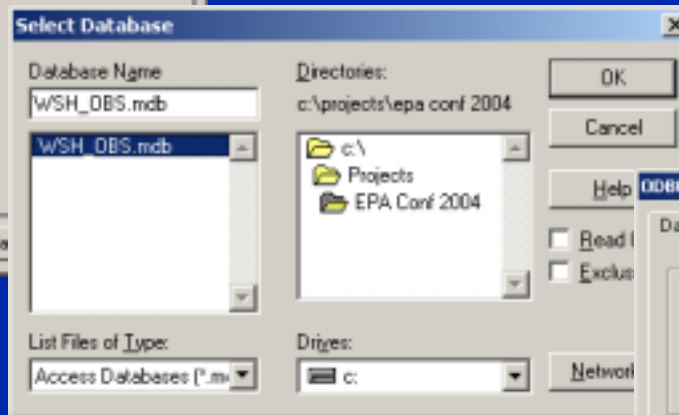


# Using Databases – SYSTAT (3 of 4)

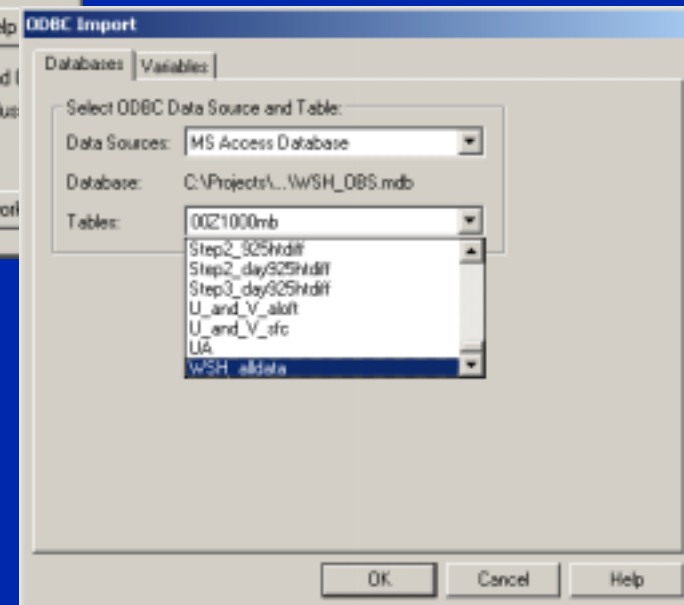
Select data source type  
(MS Access database)



Select database



Select table or query



# Using Databases – SYSTAT (4 of 4)

Untitled - SYSTAT Data

File Edit View Data Graph Statistics Help

Row: 8, Variable: DATELST 37990

	SITE\$	DATELST	PM25	MAXOFTMPC	MINOFTMPC	AVGOFDPTM	SUMOF CLOUD	CLOUDS_DAY	SUMOF PRECI	DELTAP	W
41	WSH	02/02/1999	18.00000	8.00000	1.00000	5.53846	36.00000	2.76923	0.10000	7.40000	
42	WSH	02/03/1999	6.00000	12.00000	3.00000	-2.61538	13.00000	1.00000	0.00000	-2.80000	
43	WSH	02/04/1999	13.00000	12.00000	4.00000	5.00000	28.00000	2.15385	0.01000	-2.60000	
44	WSH	02/05/1999	11.00000	10.00000	2.00000	-6.61538	12.00000	0.92308	0.00000	0.80000	
45	WSH	02/06/1999	19.00000	13.00000	2.00000	1.00000	30.00000	2.30769	0.02000	2.00000	
46	WSH	02/07/1999	23.00000	5.00000	-1.00000	1.81818	32.00000	2.90909	0.01000	8.70000	
47	WSH	02/08/1999	20.00000	7.00000	-3.00000	1.69231	31.00000	2.38462	0.00000	-7.90000	
48	WSH	02/09/1999	14.00000	11.00000	-3.00000	2.92308	36.00000	2.76923	0.00000	4.70000	
49	WSH	02/10/1999	6.00000	14.00000	-1.00000	-3.41667	15.00000	1.25000	0.00000	-1.70000	
50	WSH	02/11/1999	16.00000	19.00000	-2.00000	0.75000	16.00000	1.33333	0.00000	6.20000	
51	WSH	02/12/1999	10.00000	17.00000	2.00000	2.69231	15.00000	1.15385	0.01000	7.00000	
52	WSH	02/13/1999	6.00000	2.00000	-3.00000	-10.53846	17.00000	1.30769	0.00000	-8.40000	
53	WSH	02/14/1999	9.00000	5.00000	-3.00000	-10.69231	4.00000	0.30769	0.00000	-0.40000	
54	WSH	02/15/1999	14.00000	11.00000	-8.00000	-8.38462	7.00000	0.53846	0.00000	6.10000	
55	WSH	02/16/1999	15.00000	18.00000	-5.00000	-5.00000	15.00000	1.15385	0.00000	5.60000	
56	WSH	02/17/1999	32.00000	14.00000	1.00000	6.61538	33.00000	2.53846	0.05000	0.60000	
57	WSH	02/18/1999	25.00000	9.00000	1.00000	2.38462	30.00000	2.30769	0.21000	-1.10000	
58	WSH	02/19/1999	19.00000	6.00000	-3.00000	-2.66667	27.00000	2.25000	0.00000	3.00000	
59	WSH	02/20/1999	16.00000	5.00000	-2.00000	-5.84615	18.00000	1.38462	0.00000	-1.90000	
60	WSH	02/21/1999	10.00000	1.00000	-4.00000	-10.07692	21.00000	1.61538	0.00000	-0.70000	

Ready NUM

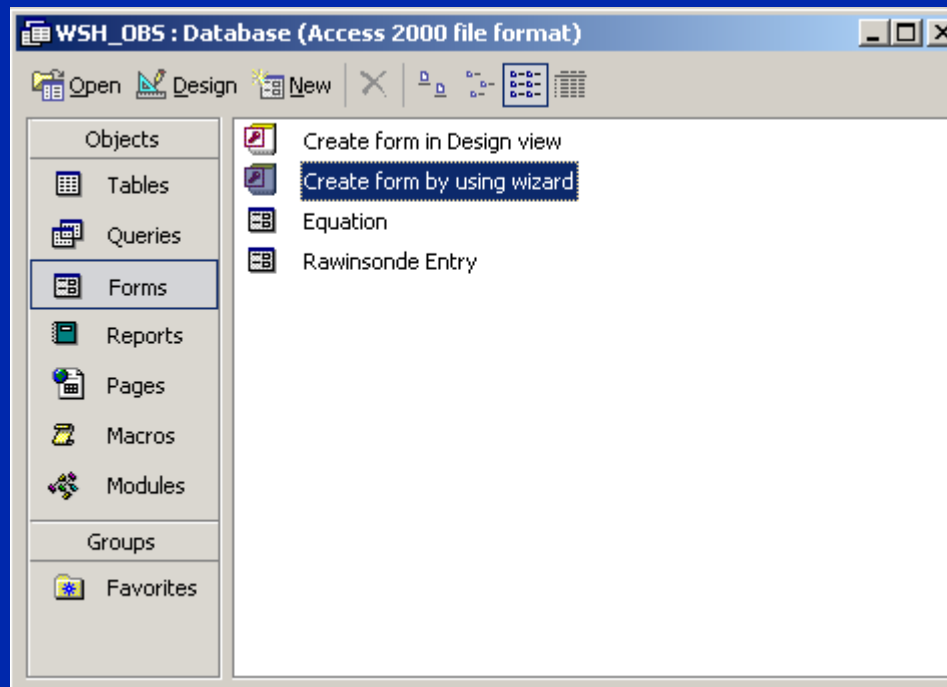
# Using Databases - Forecast Tools

- Develop a regression equation using statistical software (See Part 2 of this session)
- Set up a form to enter meteorological data needed for the equation (use the Form Wizard)
- Write a query to compute the forecast from input meteorological data fields
- *Option to add an “action button” to the form to output query results to the screen or to a report*
  - *Some simple Visual Basic coding is necessary for this step; however, Access Help can provide good guidance.*



# Forecast Tools (1 of 10)

- Set up a form to enter meteorological data
  - Select Forms
  - Select Create form by using wizard



# Forecast Tools (2 of 10)

- Select table or query to populate using form
- Select fields to include on form

**Form Wizard**

Which fields do you want on your form?  
You can choose from more than one table or query.

Tables/Queries

Query: 00Z1000mb  
Table: AQData  
Table: DateList  
Table: SFC  
Table: UA  
Table: WSH\_alldata  
Query: 00Z1000mb  
Query: 00Z500mb  
Query: 00Z700mb  
Query: 00Z850mb  
Query: 00Z925mb  
Temp (C)

Selected Fields:

Cancel < Back Next > Finish

**Form Wizard**

Which fields do you want on your form?  
You can choose from more than one table or query.

Tables/Queries

Table: WSH\_alldata

Available Fields:

00Z850mb\_Height (m)  
00Z850mb\_Temp (C)  
00Z850mb\_DPTemp (C)  
00Z850mb\_RH  
00Z850mb\_WS (m/s)  
00Z850mb\_WD  
12Z850mb\_Height (m)  
12Z850mb\_Temp (C)

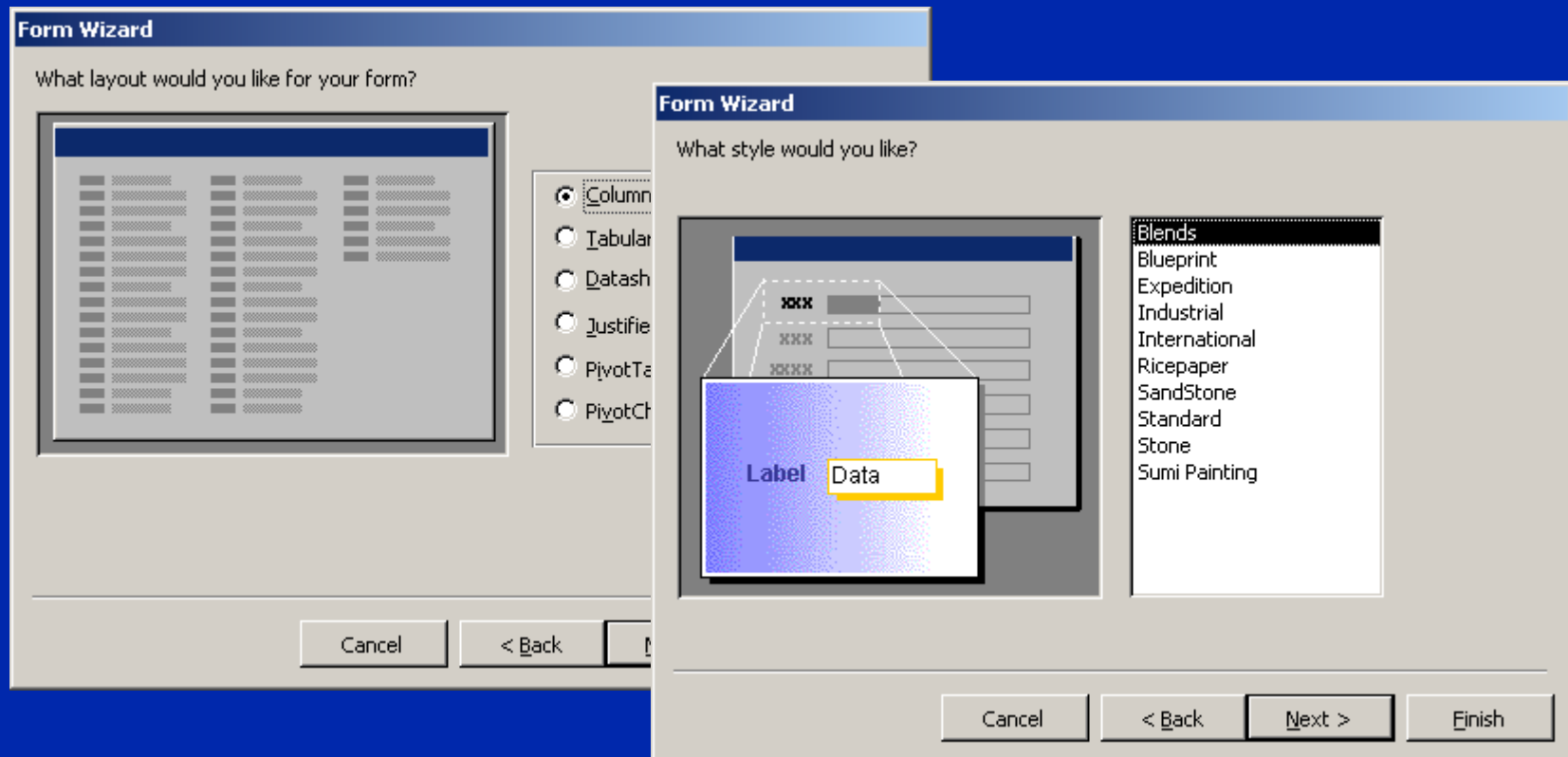
Selected Fields:

Date LST  
MaxOfTemp(C)  
WS12a6a  
12Z925mb\_Temp (C)

Cancel < Back Next > Finish

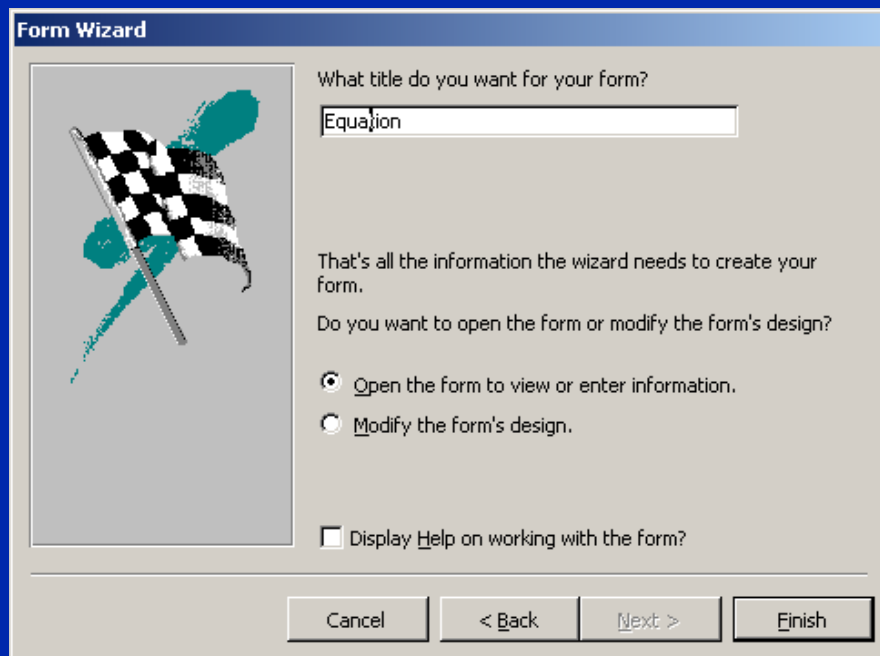
# Forecast Tools (3 of 10)

- Select form layout
- Select form style



# Forecast Tools (4 of 10)

- Name the form



The Form Wizard dialog box is shown. It has a title bar 'Form Wizard' and a left pane with a checkered flag icon. The main area contains the following text and controls:

What title do you want for your form?

Equation

That's all the information the wizard needs to create your form.

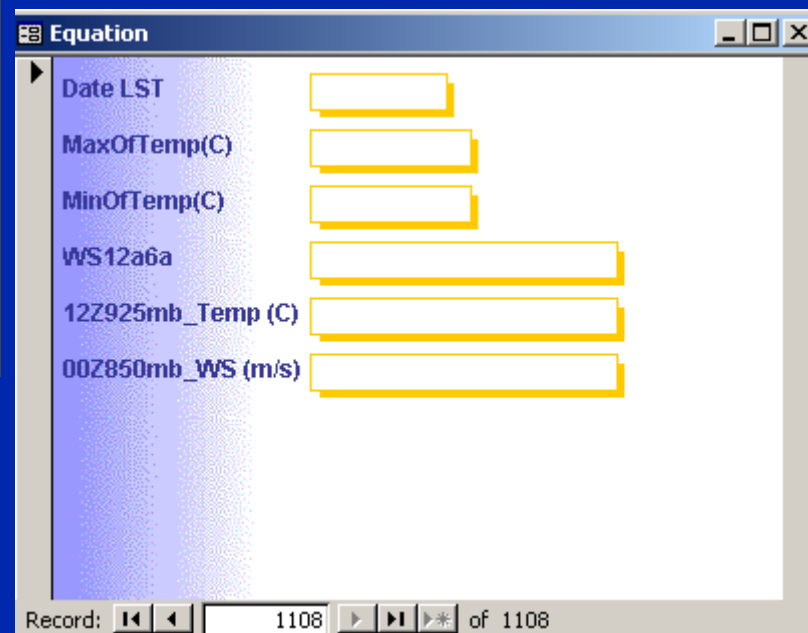
Do you want to open the form or modify the form's design?

☒ Open the form to view or enter information.

☐ Modify the form's design.

☐ Display Help on working with the form?

Buttons: Cancel, < Back, Next >, Finish



The Equation form is shown. It has a title bar 'Equation' and a list of fields with corresponding input boxes:

Field Name	Input Box
Date LST	[ ]
MaxOfTemp(C)	[ ]
MinOfTemp(C)	[ ]
WS12a6a	[ ]
12Z925mb_Temp (C)	[ ]
00Z850mb_WS (m/s)	[ ]

Record: 1108 of 1108

# Forecast Tools (5 of 10)

- Write a query to compute forecast from input data

sample\_equation1 : Select Query

WSH\_alldata

00Z850mb\_DF  
00Z850mb\_Rh  
00Z850mb\_W  
00Z850mb\_W  
12Z850mb\_He

Field:	Date LST	MaxOfTemp	MinOfTemp(C	WS12a6a	12Z925mb_Te	00Z850mb_W	PM: IIf(WSH_alldata![MaxOfTemp(C)] <> -999, IIf(WSH_alldata
Table:	WSH_alldata	WSH_alldata	WSH_alldata	WSH_alldata	WSH_alldata	WSH_alldata	
Sort:	Descending						
Show:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Criteria:							
or:							

# Forecast Tools (6 of 10)

- You can run query manually after meteorological data is added to view equation output.

**Input variables from form**      **Prediction**

Date LST	MaxOfTemp(C)	MinOfTemp(C)	WS12a6a	12Z925mb_Tem	00Z850mb_WS	PM
1/21/2004	15	0	2	10	20	21.55
1/20/2004	7	1	8	4	15	11.45
1/19/2004	2	-10	10	3	35	18.55
1/18/2004	12	-2	5	12	15	18.1
1/17/2004	3	-5	10	-9	15	5.7
1/16/2004	5	2	2	8	20	16.95
1/15/2004	10	0	15	-2	30	13.1
1/6/2004	2	-8	3	12	20	18.8
1/5/2004	4	0	15	-3	35	12.65
1/4/2004	10	0	15	5	25	13.55
1/3/2004	10	2	20	5	30	12.65

Record: 1 of 1114

# Forecast Tools (7 of 10)

- Add an “action button” to the form to output query results to the screen directly from the form
- Saves the trouble of switching to the Queries page

The 'Equation' form contains the following input fields:

- Date LST: 1/6/2004
- MaxOfTemp(C): 2
- MinOfTemp(C): -8
- WS12a6a: 3
- 12Z925mb\_Temp (C): 12
- 00Z950mb\_WS (m/s): 20

A red arrow points from the text 'to output query results to the screen directly from the form' to the 'Compute Forecast' button. Another red arrow points from the 'Compute Forecast' button to the 'sample\_equation : Select ...' window.

Record: 1107 of 1107

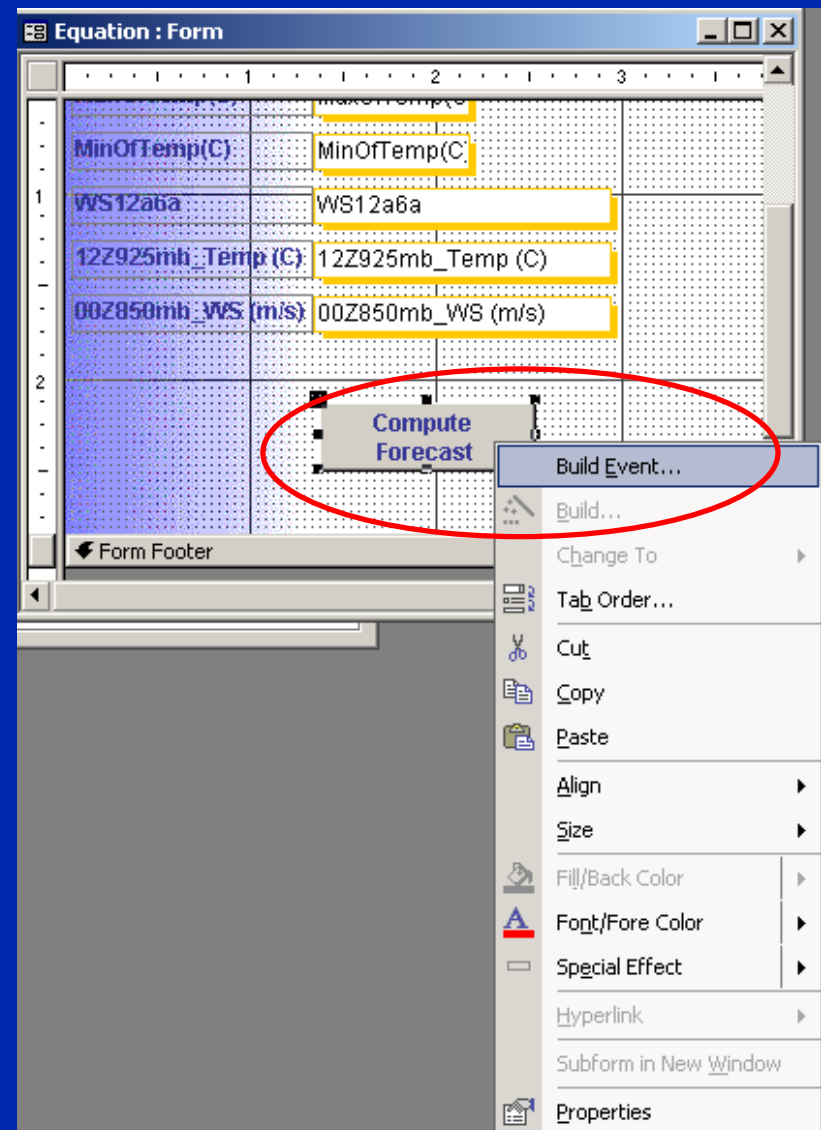
The 'sample\_equation : Select ...' window displays a table with the following data:

Date LST	PM25
1/21/2004	21.55
1/20/2004	11.45
1/19/2004	18.55
1/18/2004	18.1
1/17/2004	5.7
1/16/2004	16.95
1/15/2004	13.1

Record: 1 of 1

# Forecast Tools (8 of 10)

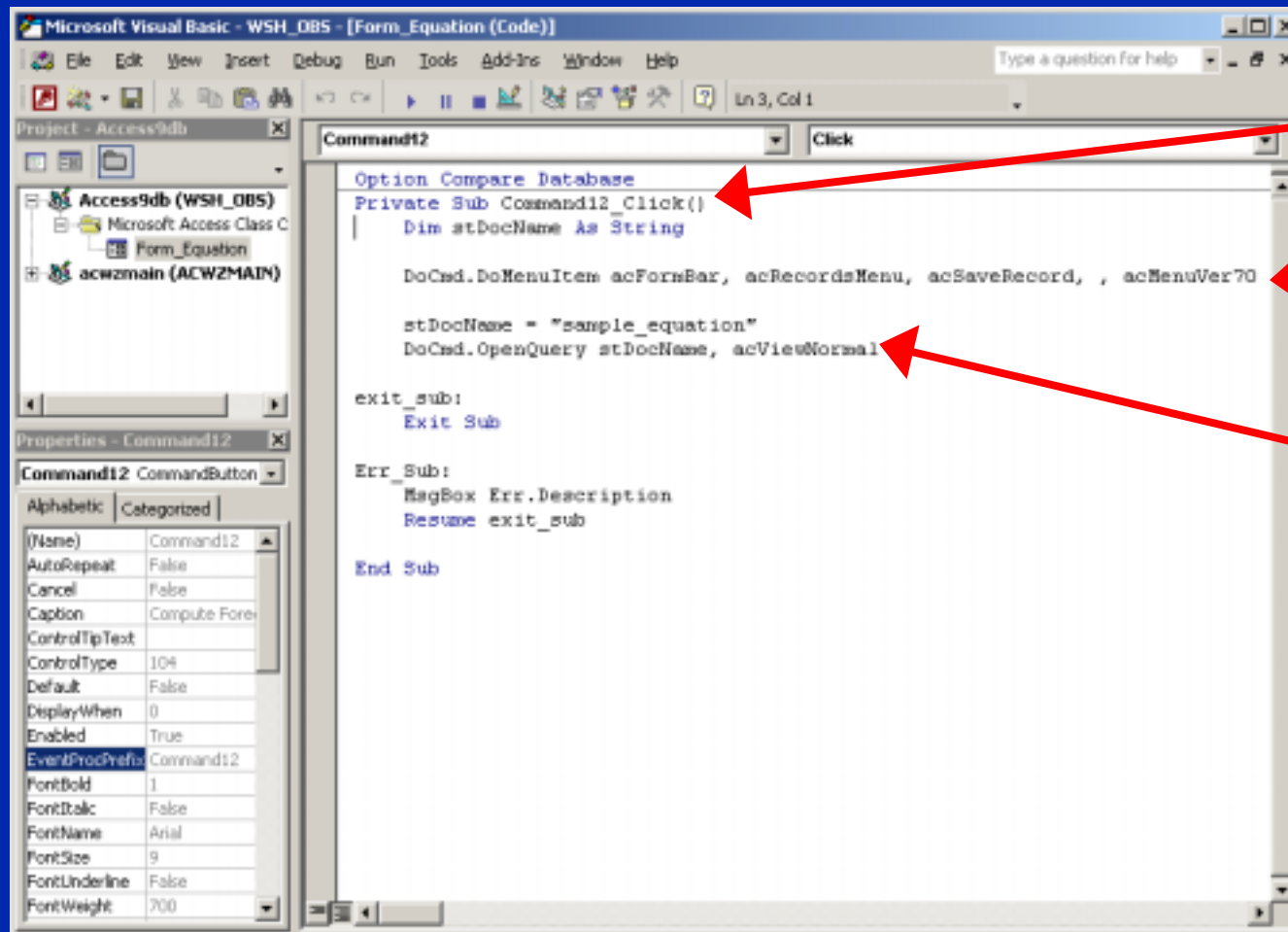
Some simple Visual Basic coding in the form design view (Build Event) is necessary to add action buttons; Access Help provides good guidance.





# Forecast Tools (9 of 10)

## Example of code for the action button



Trigger action  
on mouse click

Save the newly  
entered data

Run query  
“sample\_equation”  
and display results

# Forecast Tools (10 of 10)

Elaborate forms can be created in design view without using a wizard

**Columbus, OH Ozone Forecasting Tool**

File Edit View Insert Format Records Tools Window Help

Type a question for help

**Columbus Regional Ozone Forecasting Tool**

**Temperature Data (EST)**

	Today 10/4/2001	Tomorrow 10/5/2001
Surface Maximum	101 F	90 F
Surface Minimum	55 F	66 F
Surface at 00Z (7:00 PM)	69 F	64 F
Low point at 00Z (7:00 PM)	55 F	54 F

**Data**

	direction	speed	direction	speed
Surface at 18Z (1:00 PM)	240	6 knots	230	9 knots
Surface at 21Z (4:00 PM)	230	7 knots	240	10 knots
Surface at 00Z (7:00 PM)	210	4 knots	250	8 knots
925 mb 00Z (7:00 PM)	228	26 m/s	215	30 m/s
500 mb 00Z (7:00 PM)		20 m/s		

**Today's Ozone 10/3/2001** 60 ppb

Delete Calculate Save

**Peak 8-hr Ozone Forecast (ppt)**

	Today	Tomorrow
Mean	113	86
File Range	93 to 138	71 to 103

History Print Current Record AQI Scale

**O3History**

Observed and Forecasted Ozone (ppb) for the last 20 days

Date	Observed Ozone	Current Day Forecast	Next Day Forecast
10/2/2001	58	78	72
10/2/2001	58	67	80
10/2/2001	58	51	49
09/2/2001	58	48	35
09/2/2001	48	48	37
09/2/2001	62	63	62
09/2/2001	58	52	51
09/2/2001	48	40	39
09/2/2001	48	40	30
09/2/2001	48	41	40
09/2/2001	62	65	64
09/2/2001	58	58	62
09/2/2001	51	54	
09/2/2001	58		

Pages: 1 of 1

Record: 14 of 27

Form View

**AQI Scale**

Concentration	AQI	AQI Category
0 to 64 ppb	0 to 50	Good
65 to 84 ppb	51 to 100	Moderate
85 to 104 ppb	101 to 150	USG
105 to 124 ppb	151 to 200	Unhealthy
>124 ppb	>201	Very Unhealthy

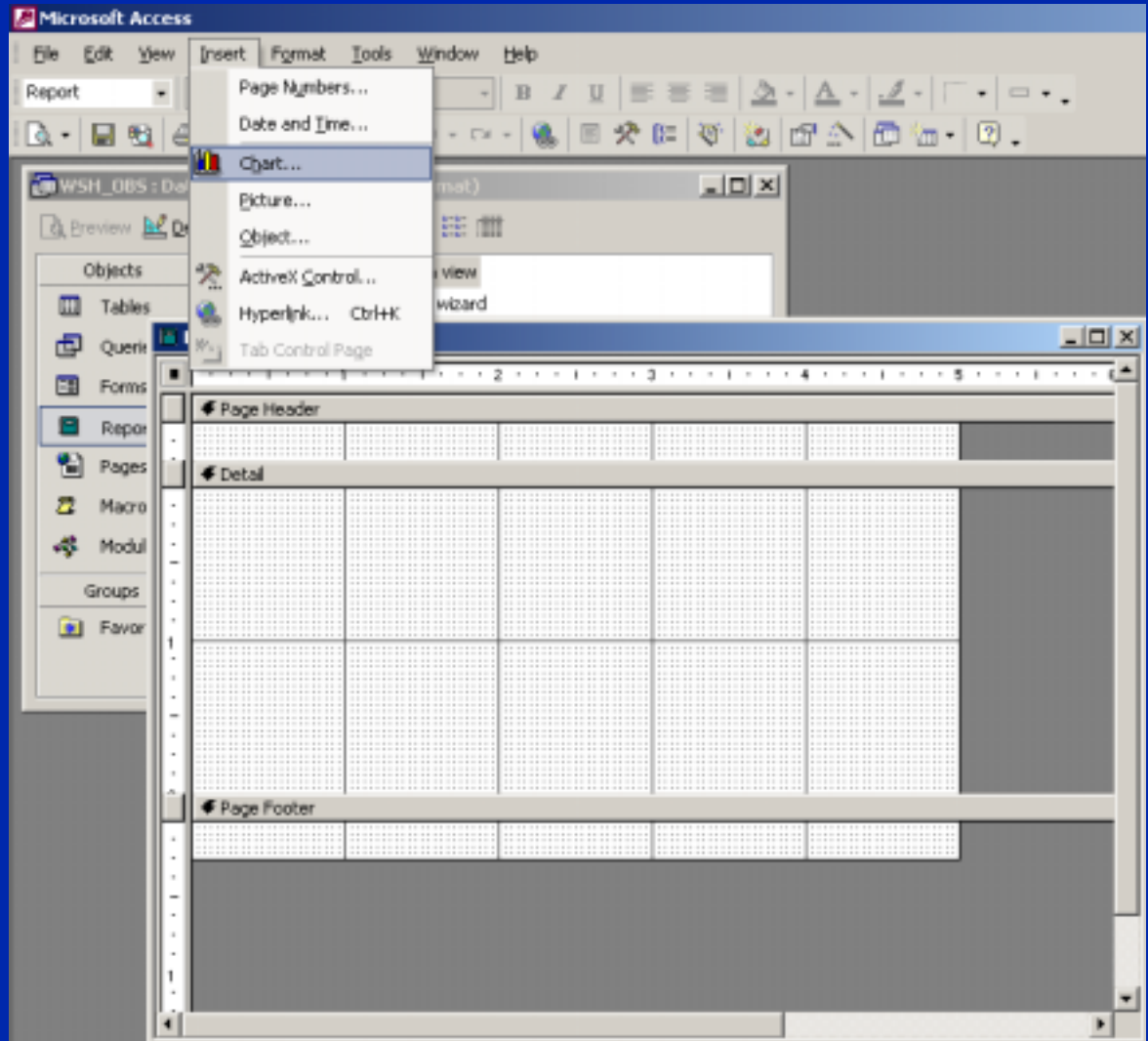
# Using Databases - Creating Plots

Graph the results of the Group By query

- Select New Report
- Select “Create report in design view”
- Select Insert, Chart
- Trace desired size of chart
- Select which table or query to plot
- Select fields to plot
- Select chart type
- Assign fields to axes or series on the chart

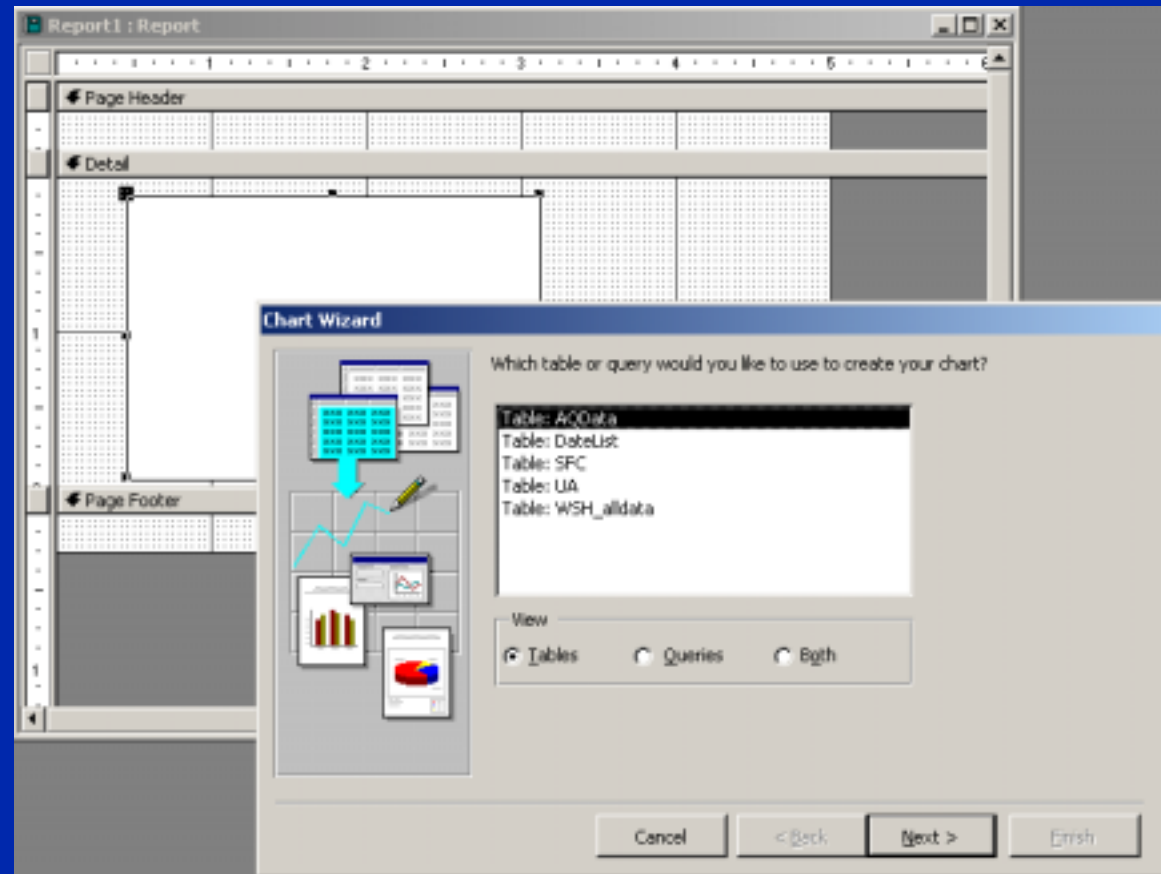
# Creating Plots (1 of 5)

- Select New Report
- Select Create new report in design view
- Select Insert Chart



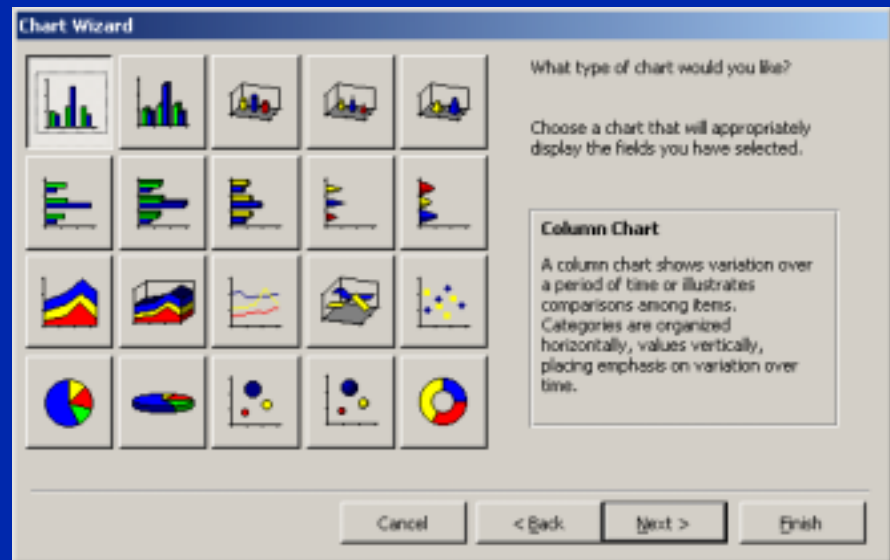
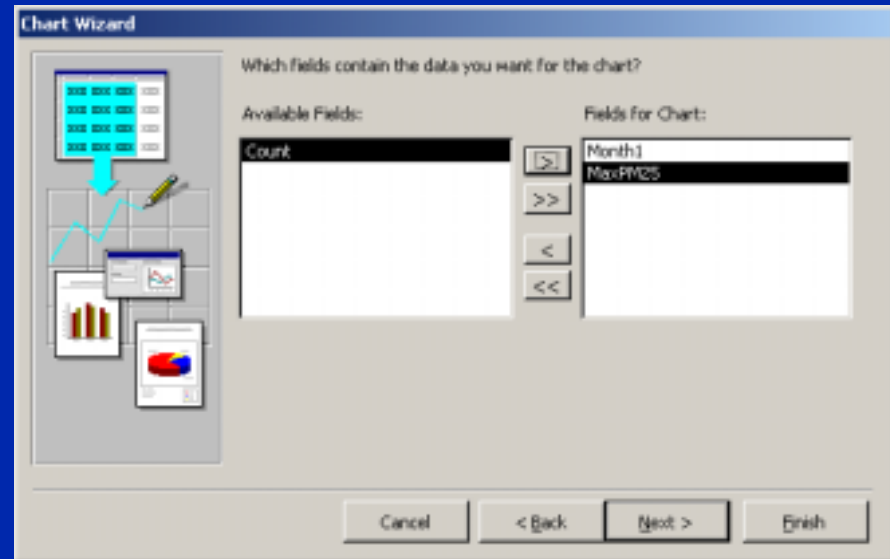
# Creating Plots (2 of 5)

- Trace desired size of chart
- Select which table or query to plot



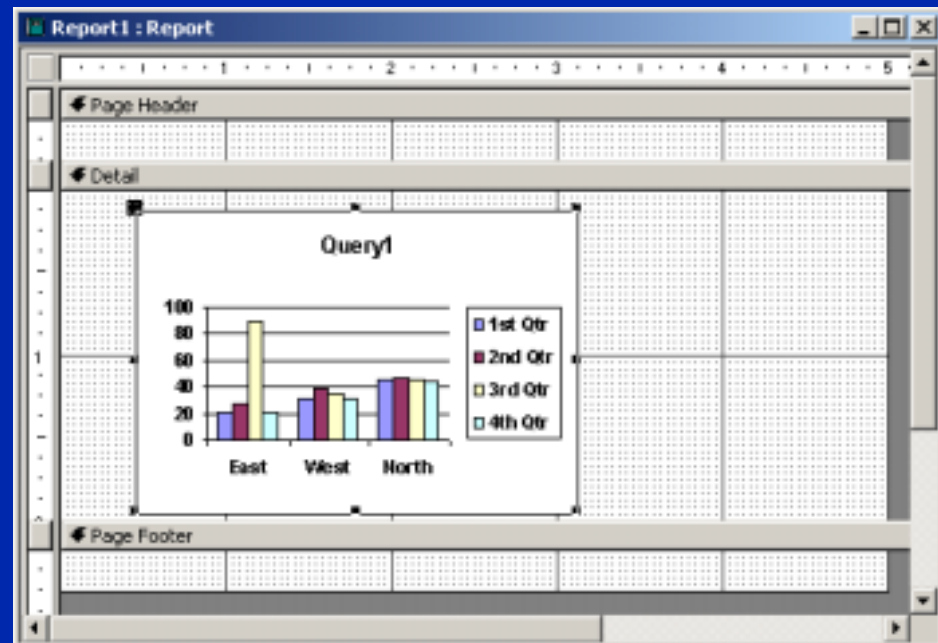
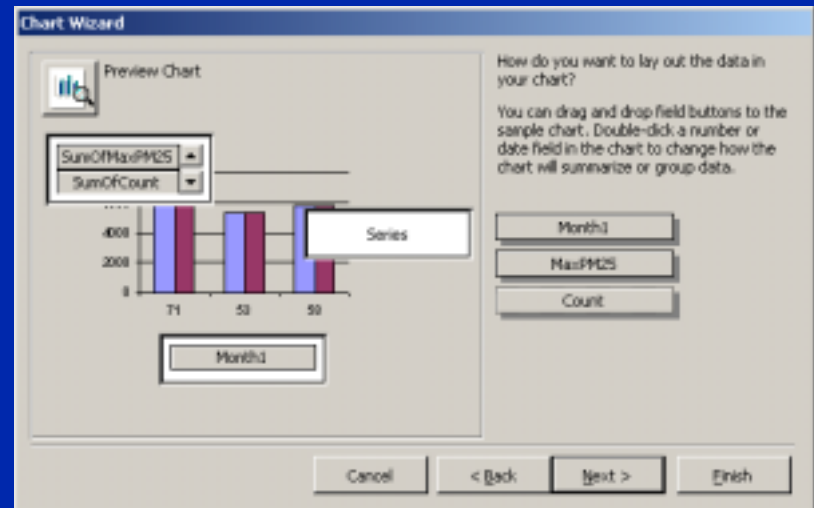
# Creating Plots (3 of 5)

- Select fields to plot
- Select chart type



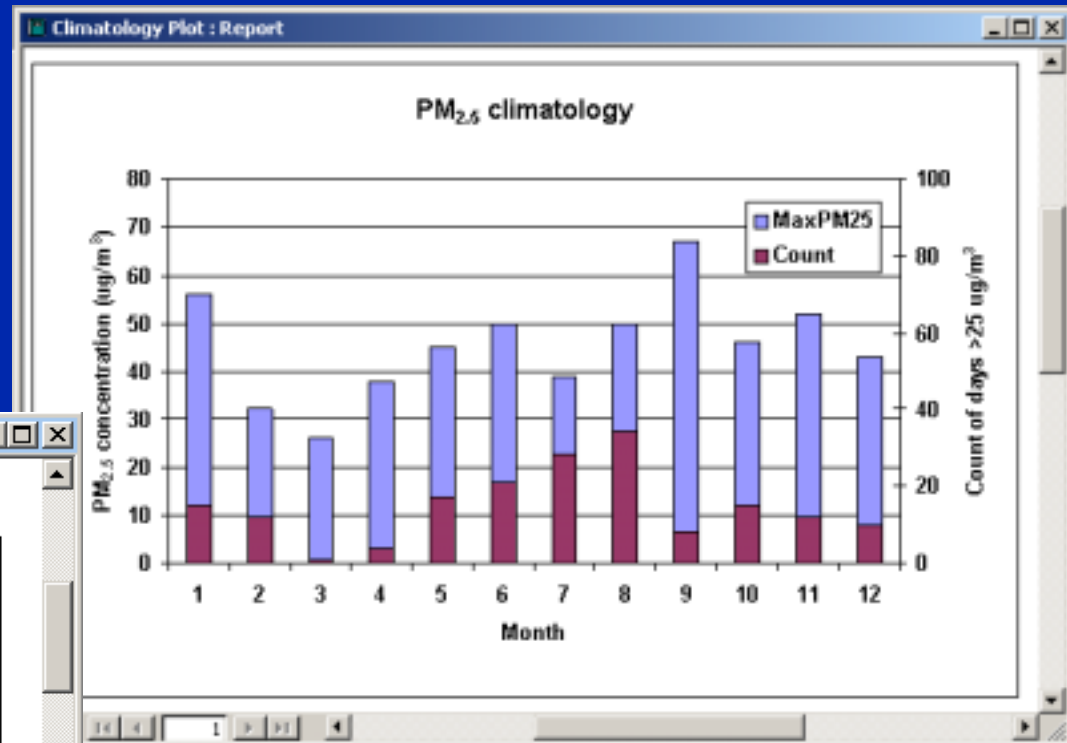
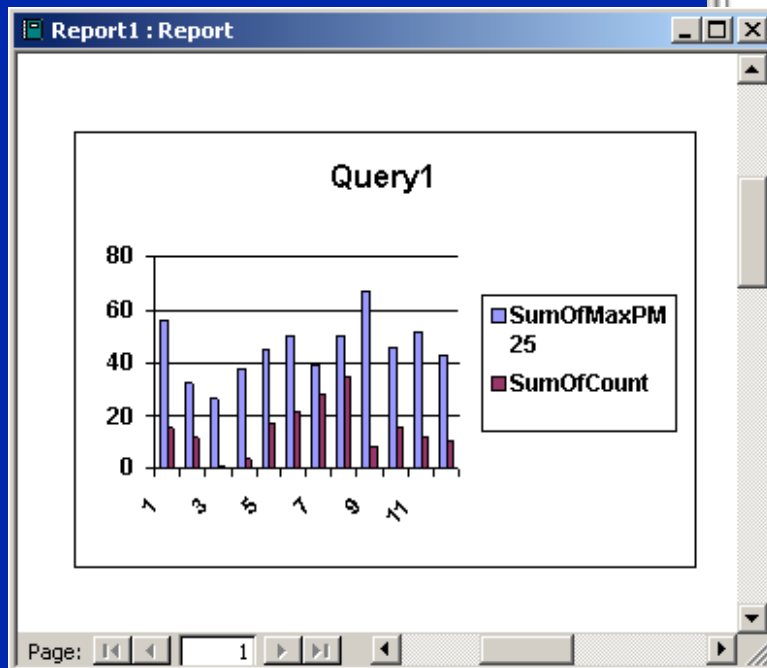
# Creating Plots (4 of 5)

- Assign fields to axes or series on the chart
- Note that the completed chart in design view is not how the chart will actually appear!



# Creating Plots (5 of 5)

- Format plot as needed, same as in Excel





# Export

- Database objects can be exported to many formats, such as .mdb, .xls, .txt, .csv, and .rtf
- Exporting a form outputs the data in the table the form is linked to. The user interface of the form cannot be exported.
- Reports have fewer export format options. Regardless of selected format, any charts in the report will not be exported.

# Summary

- Databases are a powerful storage medium and are useful for organizing, exploring, and using air quality and meteorological data.
- Queries allow for easy manipulation of data.
- External software packages can link to databases to mine data and develop forecast tools.
- Care must be taken when using databases because many actions are irreversible.

# Resources

- MS Access Help
- Local community college classes
- Microsoft Access 2002 for Dummies (John Kaufeld) – also a version for 2000
- Microsoft Access Version 2002 Step by Step (Online Training Solutions, Inc.)
- Access 2002: The Complete Reference (Virginia Anderson, Megg Morin)
- Many others – check your local bookstore!